

Sheppard Steering Conversion

PD-4104

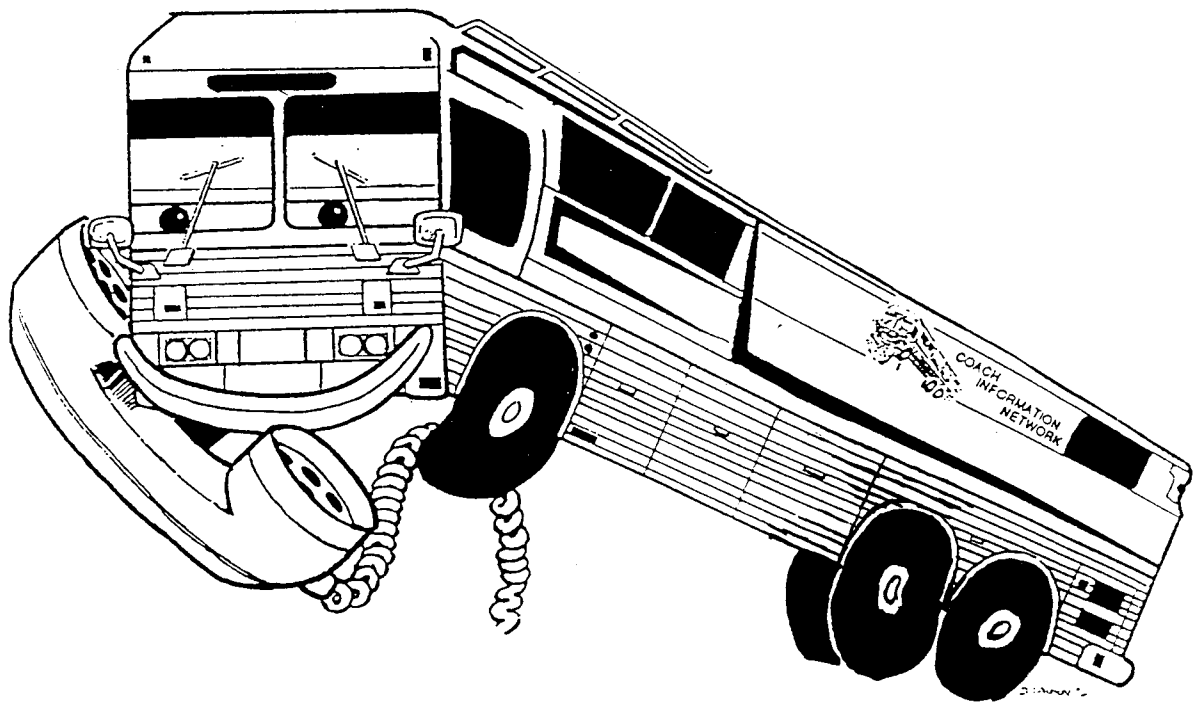
PD-4106

PD-4107

PD-4108

PD-4903

PD-4905



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The Dean Library Procedure Sheet

Sheppard Steering Conversion

PD-4104

PD-4106

PD-4107

PD-4108

PD-4903

PD-4905

POWER STEERING CONVERSION TO SHEPPARD INTEGRAL POWER STEERING

Can be used for PD4104,PD4016,PD4107,PD4108,PD4903,PD4905 which previously used Vickers Power Steering(Booster Assist) also for Manual Steering.

(Below listed parts are enough for one Coach)

<u>QTY.</u>	<u>PART NO.</u>	<u>DISCRIPTION</u>
1	2030977	Pump Asm. w/1500 PSI Relief Valve
1	2388141	Ring-Press onto Pump Body down to Flange
1	2388149	Spring-Between Hub and Coupling
1	2326310	Coupling-Hub to Eng. Internal Hub
1	2446244	Hub-Pump Drive
1	2388142	Gasket-Pump Flange to Eng. Adapter
1	19-2-29	Washer-Lock--Hub to Shaft
1	19-3-18	Nut for above-Tighten to Compress Lock Washer
1	**11G-9-2	Valve-Relief(1500 PSI)
1	681972	Reservoir Asm. w/Internal Filter P/N 11C-8-37
1	2235762	Bracket-Resv. Mounting to R.H. Eng. Hanger

*NOTE: If Coach being Converted has the Booster Assist Steering ONLY the Relief Valve in the Pump needs to be changed. The Relief Valve is under the round Pin and Cap and can be replaced without taking the Pump apart. On Coaches with Reservoir mounted on top of the pump a New Pump with remote Reservoir will be required.

1	2005364	Drag Link Tube Asm.-Adj. to 32.20" C to C of Soc
1	2005362	End Socket Asm.-R.H.
1	2005363	End Socket Asm.-L.H.
2	656259	Dust Cover for above Sockets
2	11F-4-66	Nut
2	223814	Bolt
2	1C-2-20	Washer
2	1A-1-6	Nut

NOTE: Picture on Pg. 2 of Section from Maint. Manual. Drag Link Asm mounts from bottom side

1	2011504	Steering Prop. Shaft Asm.
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NOTE: The Prop. Shaft goes between the Frt. Axle Frt. Bulkhead Center Bearing and the Gear on the Axle. On PD4104,4106 & Early 4107's the Frt. Axle is moved back toward rear so Shaft WILL require sectioning. On later PD4107,4108,4903,4905 the axle was moved forward,so the Prop. Shaft is of the correct length.

1	2404823	Steering Arm-L.H.--If needed R.H. P/N 2404822
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NOTE: Arm requires replacing as there is need of a tapered hole for the Drag Link Socket. On Manual Steering Coaches the taper in the existing arm goes the wrong way for draglink socket attachment. NOTE: Both Arms MUST be same length.

1	8885611	Gear Set(Bevel Gear)-Strg. Column Base- ratio chan
1	9411786	Race for above
1	189824	Bearing for above
1	**15550885	Gear Asm. w/Pitman Arm, Mounting Bkt. & Retainer
1	2319893	Boot-Prop Shaft Spline lace with cowhide lace
1	708055	Arm-Leveling Valve possible to use exsisting Arm
1	708056	Rod Asm.-Lateral-Has Bow in it due to taller Gear
2	12-1-206	Bushings for above Rod

NOTE: Strg. Column Ratio Change(Bevel Gears) was to give better Road Feel (1 to 1 Ratio) however it can be left at the Std. 1 1/2 to 1 ratio.

PD4104 Coaches DO NOT require change as they rotate oppo site Std.

*** ROLLER BEARING GEAR ASM.

<u>QTY.</u>	<u>PART NO.</u>	<u>DISCRIPTION</u>
1	2244570	U-Bolt--Strg. Gear R.H.
1	2244571	U-Bolt--Strg. Gear L.H.
1	*9411743	Elbow-Resv.
2	*9402866	Elbow-Resv. & Filter
2	*9402710	Connector-Filter & Gear(Return)
2	9402709	Connector-Pump & Gear(Pressure)
2	*2446712	Elbow-90 degree at Pump & Gear(use 9402709 Conn.)
1	*9411106	Elbow-45 degree at Pump(Pressure) may be required
1	*9432652	Elbow-Pump
1	*274248	O'Ring-Pump
1	3750X6	Tea-Brass-Pressure Side of Gear
1	444626	Plug-for above
1	11G-9-5	Plate-Caution-Pump--attach to Pump Body Bolt
1	1503-8	Hose-50' for 35' coach & 60' for 40" Coach
1	1503-10	Hose-50' for 35' Coach & 60' for 40' Coach
	"Above Hose is High Pressure Hose"	
12	4411-8S	Fitting Straight-#8 Hose Fitting
12	4411-10S	Fitting Straight-#10 Hose Fitting
1	**2406161K	Filter Asm-Micron(Pressure) NOT SERVICED use below
1	**11C-8-48	Head(Body)
1	**11C-8-50	Element
1	**2411802	Stud-goes thru Element into Head
1	**11C-8-52	Nut
1	**2407733	Gasket-Bowel to Head
1	**2407736	Bowel
1	**8C-11-1	Plug-Magnetic
1	**2075477	Gasket-Copper w/insulation(Insulation side to Bowl
1	2406144	Clamp for above-use at Ping Tank at Air Compressor Hose in Eng. Compartment.

ADDITIONAL INFORMATION

ITEM 1-----If Coach does NOT have Power Steering run the High Pressure hose in the same area as the air lines front to rear in Center of Coach. Most holes are already in each Bulkhead. All remaining hoses will have to be made up as they are no longer available as an Asm.--

ITEM 2-----Front Axle on PD4104, 4106 & Early 4107's are set back further as compared to later PD4107, 4108, 4903 & 4905's. In this case the New Strg. Propeller Shaft will need to be sectioned at the Main Part of the shaft to allow for the set back of the earlier type axles. It is MOST IMPORTANT that when sectioning the shaft it should be kept in mind that the shaft is a slip type and the correct length is important especially in a Coach Bounce situation. Namely when the coach goes thru a dip in the road it will raise and the shaft will try to slip apart.

ITEM 3-----Caster should be set at 3 degrees via the upper Caster Adjuster Asm. on right side above axle. Toe in should also be checked to Specs. in Maint. Manual.

ITEM 4-----SPECIAL ATTENTION: PD4104's require a different Steering Gear Asm. as the Strg. Column Bevel Gears go opposite direction(RH). Gear As. must be procured from R.H Sheppard Co.(P/N 492SEB4) Hanover, PA. 17331-0877 Attn: Roland Bouvier--717-633-4106 or 07.

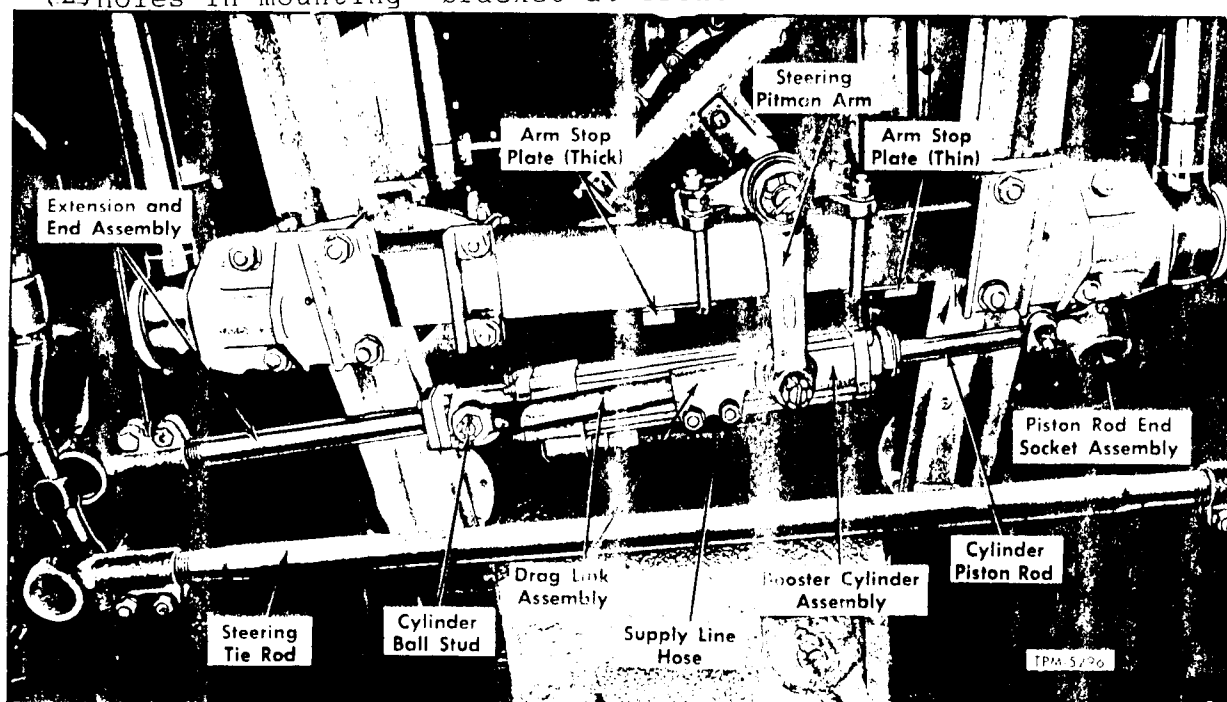
IMPORTANT: Pitman Arm Nut Torque
Split Nut Type-----675 Ft. Lbs.
One Piece Retainer Type-----450 Ft. Lbs.(uses Lock Tab)

NOTE: THIS PAGE IS ONLY FOR PD1104/4501

You will note in the below picture the Steering Gear is located slightly off center. When installing the Sheppard Steering Gear the Gear MUST be mounted in the center of the Axle Asm.

INSTRUCTIONS

Mount Pitman Arm to Output Shaft of Gear Asm. using the Arrows or Prick Punch Marks. Must be lined up exactly Arrow to Arrow or Prick Punch Mark to Prick Punch Mark. Rotate input shaft and count revolutions from one side to the other than turn back half way to center. This positions Pitman Arm in center to the rear. Take Draglink Asm and set Distance from center of socket to center of socket at 32.20" Lay Gear Asm. on top of Axle mount Drag link into LH Strg. Arm and Pitman Arm. This sets the Center of the Gear Asm. on the Axle. Drill Axle thru (2) Holes in mounting bracket at front side.



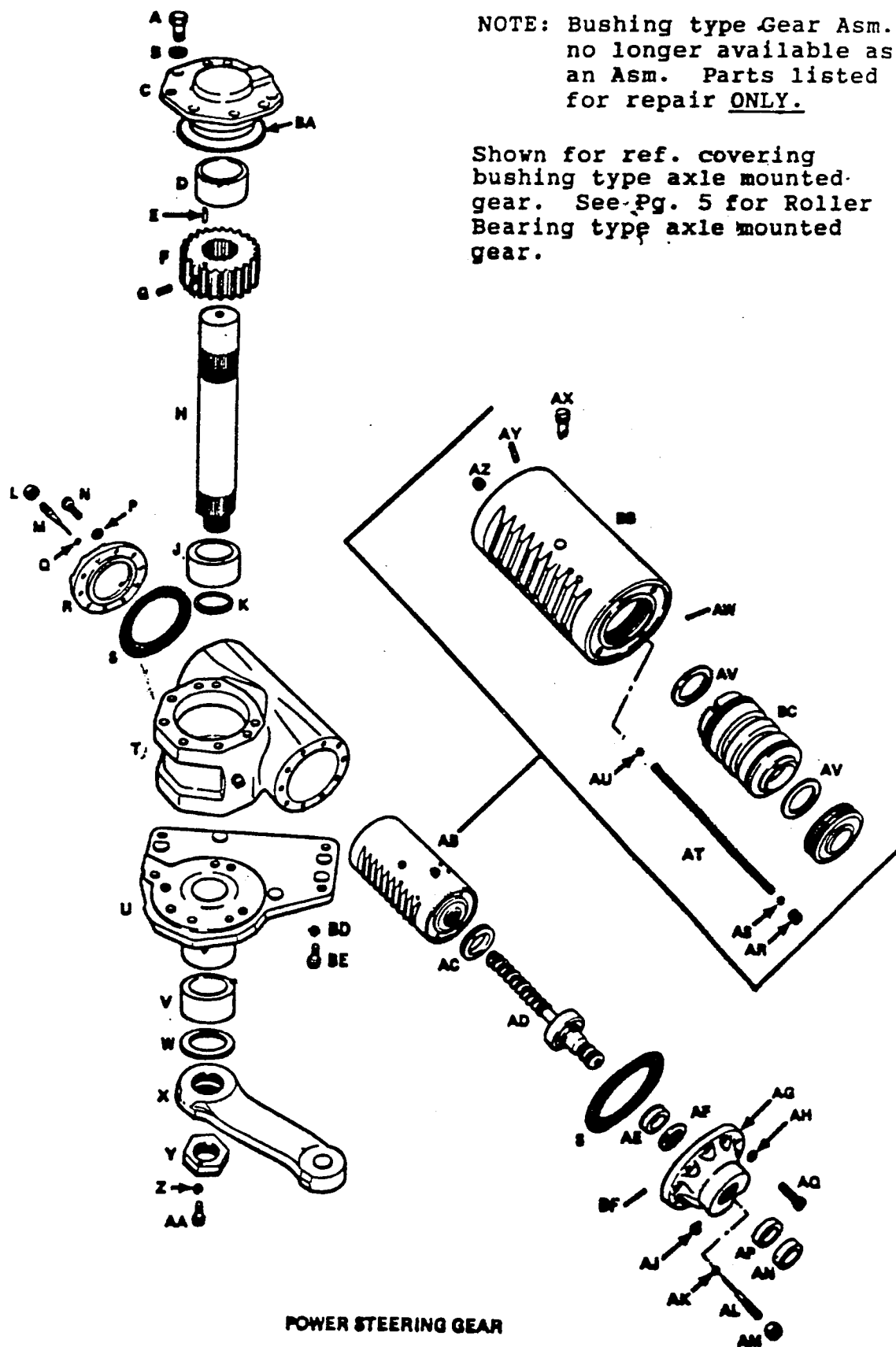
NOTE
New
rag-
link
goes
here

Figure 9—Power Steering Booster Cylinder Installed

STEERING GEAR

NOTE: Bushing type Gear Asm.
no longer available as
an Asm. Parts listed
for repair ONLY.

Shown for ref. covering
bushing type axle mounted
gear. See Pg. 5 for Roller
Bearing type axle mounted
gear.



KEY TO POWER STEERING GEAR

Bushings Type			Roller Bearing Type		
Key	Part No.	Description	Key	Part No.	Description
NOTE: Use for Repair Parts <u>ONLY</u> .					
A	NPN	Bolt(1 1/8 X 9/16")	A	NPN	Bolt(1 1/8 X 9/16")
B	9429690	Washer (9/16")	B	9429690	Washer (9/16")
C	704552	Cover-Housing	C	15577616	Cover Kit--Housing
D	704576	Bearing-Output Shft.	D	15577613	Brg. Roller-Output Shft.
E	704576	Pin - Roll	E	704576	Pin - Roll
F	704553	Gear-Output Shft.	F	704553	Gear-Output Shft.
G	704551	Pin-Retaining Gear	G	704551	Pin-Retaining Gear
H	704557	Shaft-Output	H	15577615	Shaft-Output
J	704576	Bearing-Output Shft.	J	15577613	Brg. Roller-Output Shft.
K	704566	Ring-Quad	K	15577634	Ring-Quad
L	124925	Nut-(3/8 X 24)	L	NPN	Nut-NOT REQUIRED
M	722870	Plunger-Cyl. Head	M	15577600	Kit-Cyl. Head
N	14F-1-12	Bolt-(3/8 X 1 9/16")	N	14F-1-12	Bolt-(3/8 X 1 9/16")
O	704565	O'Ring	O	704565	O'Ring
P	9439512	Washer-Lock(3/8")	P	9439512	Washer-Lock(3/8")
Q	704565	O'Ring	Q	704565	O'Ring
R	2006635	Head-Cyl	R	15577593	Kit-Head-Cyl
S	2006636	Gasket	S	15577592	Kit-Gasket &
T	704554	Housing	T	15577620	Kit-Housing
U	700074	Bracket-Mounting	U	15577627	Kit-Bracket-(2917824K)
V	704576	Bearing (2916234K)	V	15577613	Brg. Roller
W	11J-1-72	Seal-Oil	W	15577632	Kit-Output Shaft
X	700078	Arm-Pitman(2567303)	X	15577626	Arm-Pitman(2584733)
Y	704569	Nut-Retaining	Y	15577622	Kit-Retaining
Z	103320	Washer-Lock(5/16")	Z	15577622	Kit-Retaining
AA	9406772	Screw-cap	AA	15577622	Kit-Retaining
AB	2045035	Mated Kit w/shaft	AB	G5007835	Mated Kit w/shaft
AC	704568	Nut-Retaining	AC	----	Nut-Retaining
AD	2045035	Shaft(in mated kit)	AD	G5007835	Shaft(in mated kit)
AE	704561	Seal-Hi-Pressure	AE	15577266	Kit-Hi-Pressure
AF	712991	Washer-Seat	AF	----	Washer-NOT REQUIRED
AG	2006634	Cap-Bearing	AG	15577598	Kit-Cap Bearing
AH	9439512	Washer-Lock(3/8")	AH	9439512	Washer-Lock(3/8")
AJ	712992	Fitting-grease	AJ	712992	Fitting-Grease
AK	704565	O'Ring	AK	704565	O'Ring
AL	722870	Plunger(Input end)	AL	15577264	Kit-Input Shft. End
AM	124925	Nut(3/8-24)	AM	----	Nut-NOT REQUIRED
AN	704563	Seal-Salt	AN	15577592	Kit-Gasket & Seal
AP	712990	Seal-Dirt	AP	15577592	Kit-Gasket & Seal
AQ	14F-1-12	Bolt-(3/8 X 1 9/16")	AQ	14F-1-12	Bolt-(3/8 X 1 9/16")
AR	703895	Seat-Valve	AR	703895	Seat-Valve
AS	704559	Ball-relief valve	AS	704559	Ball-relief valve
AT	703896	Spring-ball	AT	703896	Spring-ball
AU	704559	Ball-relief valve	AU	704559	Ball-relief valve
AV	703897	Spring-reversing	AV	703897	Spring-reversing
AW	703900	Pin-locking	AW	703900	Pin-locking
AX	703898	Pin-Positioning	AX	703898	Pin-Positioning
AY	704571	Pin-roll	AY	704571	Pin-roll
AZ	703895	Seat-Valve	AZ	703895	Seat-valve
BA	704575	O'Ring	BA	704575	O'Ring
BB	2045035	Mated Kit(Piston)	BB	G5007835	Mated Kit(Piston)
BC	2045035	Mated Kit(Valve)	BC	2045035	Mated Kit(Valve)
BD	9429690	Washer (9/16")	BD	9429690	Washer (9/16")
BE	NPN	Bolt(9/16-18X1 3/8")	BE	NPN	Bolt(9/16-18X1 3/8")
BF	15586107	Pin-Locking actuate	BF	15577598	Kit-Input shaft actuate



Coach Service Information Bulletin

GMC TRUCK & COACH DIVISION GENERAL MOTORS CORPORATION

IMPORTANT—All Service Personnel Should Read and Initial

NUMBER: C-76-I-25

GROUP: 16-Steering-11

DATE: May, 1976

SUBJECT: PART #2011504 STEERING PROP SHAFT
ASSEMBLY - REAR FOR USE WITH
SHEPPARD POWER STEERING

MODELS: INTERCITY COACHES WITH SHEPPARD
POWER STEERING

EFFECTIVE: PRODUCTION & SERVICE

The purpose of this bulletin is to inform coach operators of a new rear steering prop shaft for Intercity coaches equipped with Sheppard Power steering.

INFORMATION

A change has been made in the rear steering prop shaft assembly. Prop shaft #708608 used bushing type bearing journals. As a product improvement, part #2011504 prop shaft assembly has been released for production and service (See Figure 1).

NOTE: The only difference between #708608 prop assembly and the new #2011504 prop assembly is the bearings. Part #708608 has the bushing type bearings and part #2011504 has needle bearings. The needle bearing kits #2011875 are interchangeable with the former #3918866 bushing type bearings.

CAUTION:

To prevent bearing wear and splined joint seizure, it is most important to grease the universal joints and splines at least every 3,000 miles with a good quality lithium soap multi-purpose high temperature extreme pressure grease. When lubricating the Splined end the relief hole in the end should be plugged while lubricating to force the grease down the splined shaft.

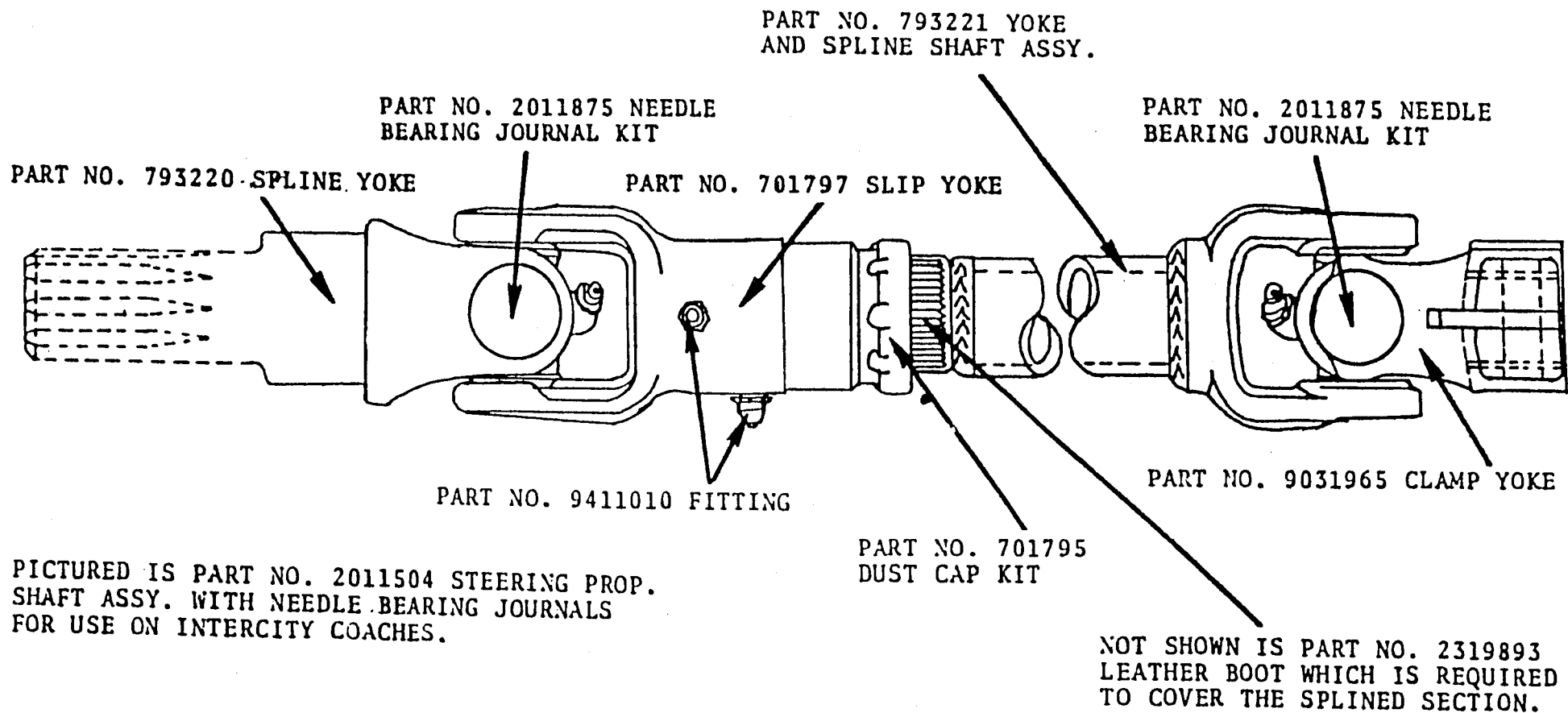


FIG.1

PROCEDURE SHEET

SYSTEM
Sheppard Power Steering Conversion

APPLICATION
GMC Models

Part A - Power Steering Pump Rotation and Relief Valve
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Introduction

This conversion is necessary if you purchase a new MCI pump, which has an opposite rotation from the GM pump. When using a pump made for the MCI or a GMC coach with a booster assist steering, a 1500 psi relief valve (part # 11G-9-2) must be installed. A new GM style pump (part # 2030977) would not require this service. If you're going to use your existing pump, it's wise to check the internal parts by this same procedure.

A new pump with a remote reservoir must be installed on coaches that have a reservoir mounted on top of the pump, such as the PD4104 and some of the early model PD4106's. When installing a new style GM pump on the PD4104, you will be required to machine the woodluff key on the new pump to fit the original PD4104 pump drive hub.

1. To change the pump rotation, first place the pump in a vise with the shaft pointed down and the back of pump pointed up. Remove the four 3/8" bolts and gently remove the back housing from the main pump body.

NOTE: For pump break down see Fig.1.

2. Remove the pressure plate from the pump ring, and gently lift the pump ring off the dowel pins. Place the pump ring back on dowel pins with the arrow on the side of the ring facing in the direction shown in Fig 1. Re-install the pressure plate on the pump ring. Place the spring on the pressure plate and install the back housing to the main body. Make sure you check the O Ring on the main body for proper seating. Tighten 3/8" bolts in cross pattern to 25 to 30 ft lb.

3. Remove the lock pin from the relief valve. Remove the relief valve plug and relief valve. Install the new 1500 psi relief valve with the bolt head end of valve against the spring. Install the relief valve plug and the lock pin.
4. Install the drive hub and fittings on the new pump. Make sure to replace the O Ring on the pressure fitting of the pump. Install the new pump on the engine.
5. Because the Sheppard Steering System uses a 5W30 or 10W40 (API SD-SE) motor oil instead of ATF, you must flush as much of the old fluid out as possible! You can do this by pumping new oil through the system or with air pressure. It is necessary also to clean the permanent filter on the bulkhead and change the filter in the reservoir. (See Fig 1A) While flushing the system, check and note which line is "Pressure" and which is "Return" on the front of the bus for future hookup. Because of added pressures, it is a wise precaution to replace all fluid hoses front and rear.

PART B - Removing Old Steering Parts and Component Check

1. Remove the following old steering components: booster cylinder, steering box and steering shaft. Clean and lay aside the steering shaft and the U bolt assemblies for future rework.
2. Check the left hand steering arm to see if it has a tapered hole to accept the new drag link assembly. (See Fig#3) If a tapered hole exists, make sure that the wide part of the taper is on the bottom of the steering arm. The new drag link assembly must be installed from the bottom side of the steering arm. If the taper of the hole is wrong then the steering arm must be replaced.

NOTES:

- a. If a tapered hole does not exist in the left hand steering arm, but instead, the steering arm has a flat boss in it's center where a hole should be, then the steering arm can be removed and a tapered hole machined into it to accept a new drag link.
- b. On the PD4104, there is a gas tank mounted behind the front axle that was used for the air conditioning motor. If this gas tank is still being used, the best course to take may be to

- remove the left hand control arm and have a tapered hole machined into it.
- c. If longer control arms are installed on these coaches, there can be problems with clearance between the tie rod and gas tank. If a different length control arm is installed, both the left and the right control arm must be the same length.
 - d. Machining a tapered hole into the control arm should only be performed by an experienced machinist. Never machine a tapered hole into a control arm that does not have a flat boss in it's center.
 - e. Removal of the old steering arm can be tricky because it requires the use of some fairly big sockets and other tools, as well as a torch to heat areas around the steering arm.
3. Remove the cotter pin and castle nut from the steering arm. Heat the area on the spindle where the steering arm comes through, and drive out the steering arm with a drift bar and hammer. Install the new (or reworked) steering arm and tighten the castle nut to 500-550 ft. lbs Install new cotter pin.
4. Check the angle drive box for excess back lash, roughness or tight spots. Check the center steering shaft for wear in the U-joint and bearings. Old steering components that are to be reused should be checked for wear, and rebuilt or replaced if needed. Your new steering system is only as good as the old parts you reuse.

NOTE: Angle drive box ratio can be 1 to 1, or 1.5 to 1. Both ratio's will work.

5. Support the body of the bus and remove the old leveling valve assembly. This will be reworked later. Also remove the old turning stops if they are mounted on the front axle at the pitman arm.

Part C- Installing a New Steering Box, Pitman Arm and Drag Link

NOTE: On some of the later model GMC coaches, a top lateral radius rod (part#708056) may be required. This radius rod has a bow in it to accept the taller Sheppard Steering Gear.

1. Clean the axle and install the new steering box, minus the pitman arm. Install the 2 front mounting bolts first but do not tighten. Install the U-bolts using the new self locking nuts and spacer's, or washers under nuts where needed. Tighten the front bolts to 170-180 ft lbs. Tighten the U-bolt to 90 - 110 ft lbs.
2. Before installing the pitman arm, find the center point of the steering box. Wrap a rag around the actuating shaft of the steering box and with channel block pliers, turn the steering box in one direction until it stops. Then turn the box in the other direction while counting the total number of turns of the actuating shaft. Finally, to find the box center, turn the shaft in the other direction for half the number of total turns.
3. Install the pitman arm on the box with factory marks on the pitman arm and specter shaft aligned. The pitman arm should point toward the center of the bus with the steering box centered. Secure the pitman arm with a nut but do not tighten.
4. With the wheels of the bus straight, and the steering box in the center position, adjust the new drag link ends so that the link can be installed on the pitman arm and steering arm without moving the wheels or steering box off center. Try to keep the same amount of threads showing on both drag link ends as possible. Close to 32.20 center to center (see Fig 3). Tighten the drag link clamp locks with the bolts toward the rear of the bus. Tighten the drag link end to the left hand steering arm and install the cotter pin. Do not tighten the drag link end to the pitman arm until after the air in the system is bled. (Later in Part F.)
5. Install the fluid line fittings into the steering box. Viewed from the front of the box, the pressure fitting is on the right side (round part of box). The return is on the left side at the

rear square part of the box. Point both fittings toward the rear of the bus. Install new hoses on the box, leaving a big enough loop for up and down movement of bus.

Part D - Steering Shaft Assembly - (See Fig 4)
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NOTES: In this procedure, the original steering shaft will be sectioned and reused. There is a new shaft (part# 2011504) that can be used if desired. However on the PD4104, PD4106 and the early model PD4107's, the front axles are set back further as compared to the later model PD4107, 4108, 4903 and the 4905's. In this case the new steering shaft would also have to be sectioned to allow for the set back of the earlier type axles.

On the later models 4107, 4108, 4903, and 4905's the axle was moved forward, so the new steering shaft would not have to be sectioned. When reusing the original steering shaft you will need to order a yoke for the Sheppard Steering Gear (part#9031965) and also a U-Joint (part#2011875). A new yoke for the original steering shaft that will match the yoke on the steering gear can be purchased at a truck supply center that sells P.T.O. (Power Take Off) equipment

1. Lower the bus body down to rest on rubber stop pads.
2. Take the long part of the old steering shaft and at the end where the U-joint is, cut the end off the shaft right behind the weld. Now take the new steering gear yoke and the new steering shaft yoke and assemble them with U joints. Place yoke assemblies onto the steering box and install clamp bolt into the groove of the actuating shaft of the box (do not tighten clamp bolt).
3. To obtain the proper steering shaft length first install the short end (female end) of the old steering shaft onto the bulkhead yoke and secure with one U bolt. Install the long end of the old shaft (the one just cut) into the splines of the female yoke. Slide the shaft into the yoke until it is flush with the bottom of the female yoke. Back the shaft out of the yoke approximately 1" to 1 1/2" and hold in this position. With the new yokes on the steering box held in one hand, and the steering shaft in the other, hold the two sections side by side.

Start cutting steering shaft a little at a time, checking after each cut until the two sections will fit together. You want the steering shaft end that was cut to fit flush inside it's new yoke (see Fig 4). Also you want the splined end of the shaft to be 1" to 1 1/2" from the bottom of female yoke.

4. When the proper steering shaft length is found, remove the steering shaft from the bus and reclamp assembly into vise. With shaft assembly clamped in vise, line up the yokes at each end as shown in Figure #4. Now bring the shaft assembly to same length as obtained under bus. Spot weld the new steering shaft yoke assembly to the steering shaft. After the spot weld is made, remove the shaft assembly from vise and re-install with one U bolt as was done in section#3.
5. With the steering shaft assembled on bus, raise the bus body away from the axle until there is approximately 6 inches clearance between the rubber stop pads and axle. (See FIG.5). Check the splined sections of the steering shaft to make sure they maintain 50% contact with each other!!! (See FIG.4). Now lower the bus body down against rubber stop pads. Check the splined parts of steering shaft assembly here to be sure they Do Not Bottom Out against each other. If the steering shaft fit is correct, remove the shaft assembly from bus and weld securely.
6. With the steering shaft completed, you are ready to install it on the bus with the steering wheel in its proper position. Have someone hold the steering wheel so that the Y shape of the steering wheel center arm is in an upside down position. Install the steering shaft onto the bus by attaching it first to the bulkhead with U bolts. While holding the steering wheel in position and the wheels of the bus straight ahead, attach the steering shaft to the steering box. If while road testing the bus the steering wheel is not at this position with wheels straight, the steering wheel itself can be removed and reset.

PART E - Leveling Valve

1. At this point we need to rework the leveling valve system so you can run the engine later when bleeding the system without a lot of air leaks.
2. Lower the bus body down against the rubber stop pads. Here you will notice that a certain amount of material must be removed from the bottom of the leveling valve mounting bracket. Remove enough material from the bottom of bracket to obtain no less than 1/2" clearance between the steering box and mounting bracket.
3. Raise the bus body up approx 3" from the rubber stop pads. Leveling valve (part #5549704) can often be the best valve to use, because it comes with a long mounting bracket and a large offset in the "over travel lever" which makes it easier to adapt in this procedure (See Fig,#5A). Mount the new leveling valve to the passenger side of the body bracket. The over travel lever should be pointed toward the rear of the bus. Mount the leveling valve so that the over travel lever can swing up and down at least 120 degrees and the over travel lever is close enough over the top of the axle to later attach the adjusting arm to the bottom bracket (See Fig#6). If needed, remove the over travel lever from valve and flip over. This will extend the offset in the lever away from the steering box.
4. The next step is to attach the air lines on the bus to the new leveling valve. The easiest way to do this is to cut off short sections of old copper lines where they attach to the leveling valve, approx 6"long. With the use of 1/4" compression ring pipe unions and 1/4" plastic air line you can attach plastic air line to the short sections of copper lines at the leveling valve and then attach the other end of plastic line to copper air lines on the bus.
5. After the air lines are hooked up, test the system for proper operation and air leaks. Attach an outside air source to bus (Do Not Start Engine) and fill the air system to approx 100 psi. Hold the over travel lever up and allow bags to fill until there is approximately 3 inches at the rubber pads. Move the lever to center position to stop air flow to bags. Refill the air system to approx 120 psi. Allow the bus to stand while carefully

listening for air leaks. You can also use soap & water around fittings & connections to check for leaks.

NOTE: The leveling valve adjusting rod can be made by your specifications, or can be ordered through The DialBus Network.TM

PART F - Bleeding & Relief Valve Plungers Adj.
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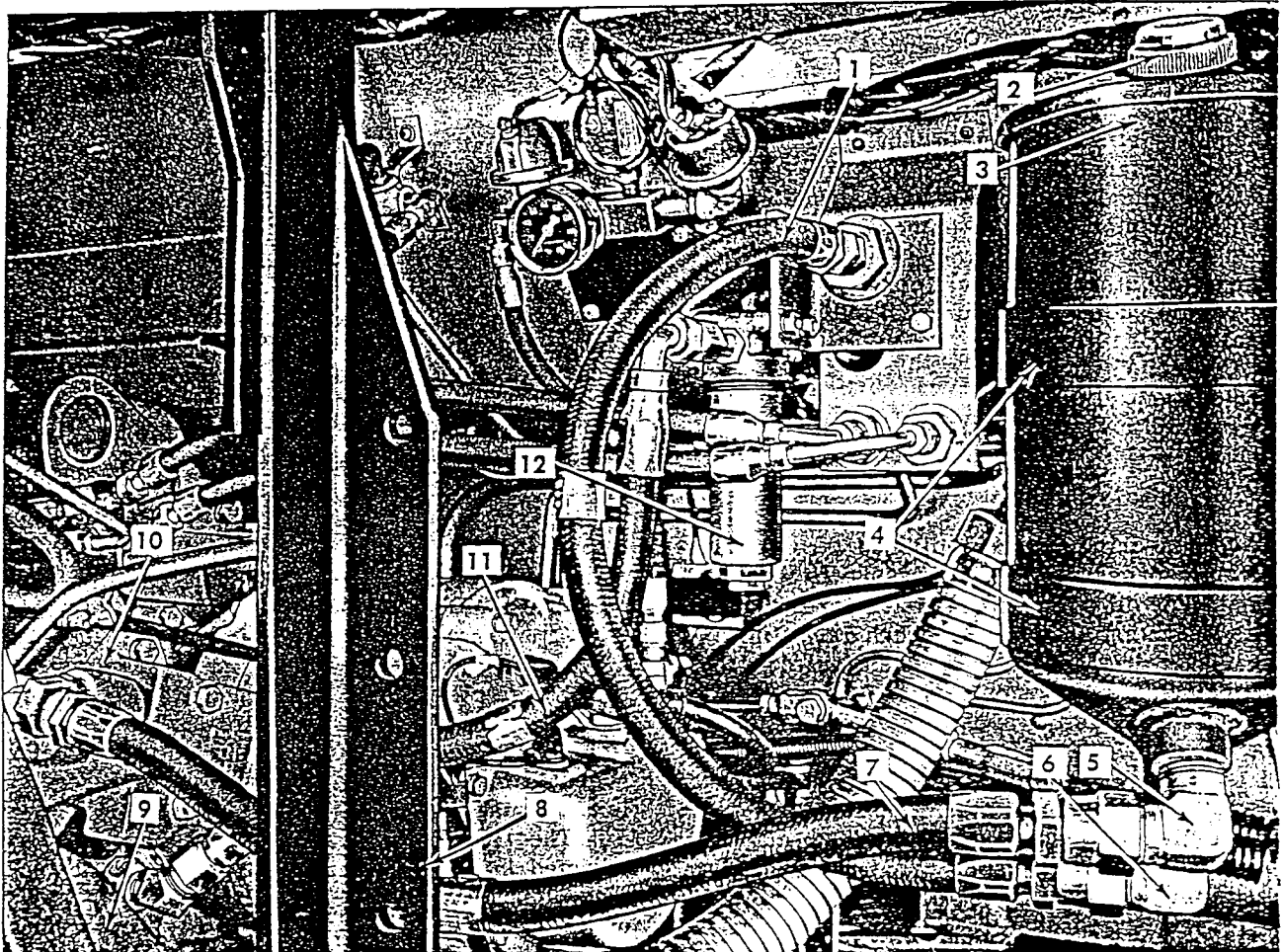
1. We will follow the Sheppard instruction supplied with this booklet on such items as bleeding and also on pitman arm installation except for one difference. Where Sheppard disconnects drag link from pitman arm, we must disconnect the pitman arm from the steering gear. If pitman arm is not removed it will hit the axle before box reaches full turn and allow some air to remain trapped in box.
2. After the bleeding by Sheppard instructions is complete, re-attach the pitman arm to the box and the drag link, if removed, and finally tighten. Follow the Sheppard Pitman Arm Installation Instructions.
3. Install front wheels on bus and lower to floor. At this point you can start the engine to test steering and check for leaks. Do not turn the wheels against wheel stops until relief valve plungers and axle stop are adjusted using Sheppard Instructions.

NOTE: When adjusting the turning radius make sure that the tires do not rub anything. The rule of thumb is the width of palm between the air bag and the tire.

Library Facts Sheet

Figure #1A

POWER STEERING.



- 1 Return Line From Booster
- 2 Filler Cap Assembly
- 3 Reservoir Shell Assembly
- 4 Support Clamps

- 5 Reservoir Outlet
- 6 Reservoir Inlet
- 7 Return Line to Pump
- 8 Engine Support Hanger

- 9 Air Compressor
- 10 Hydraulic Pump
- 11 Pressure Line to Booster
- 12 Fluid Line Filter

Library Facts Sheet

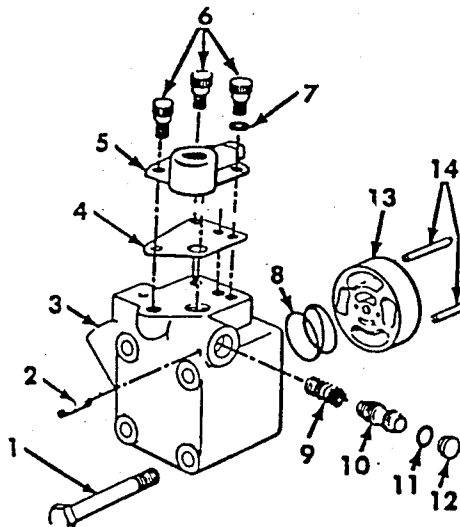
Figure #1B

POWER STEERING

- 1 Capscrew
- 2 Retaining Pin
- 3 Cover
- 4 Manifold Gasket
- 5 Manifold

- 6 Manifold Capscrews
- 7 Copper Washer (1 Only)
- 8 Pressure Plate Spring
- 9 Flow Control Spring
- 10 Relief Valve

- 11 O-ring
- 12 Relief Valve Plug
- 13 Pressure Plate



- 14 Locating Pins
- 15 Pump Ring
- 16 Rotor
- 17 Vane
- 18 O-rings
- 19 Pump Body
- 20 Pump Shaft Seal
- 21 Inner Retaining Ring
- 22 Pump Shaft
- 23 Woodruff Key
- 24 Ball Bearing
- 25 Outer Retaining Ring

T-2213

View from Back of Pump

Fig 1

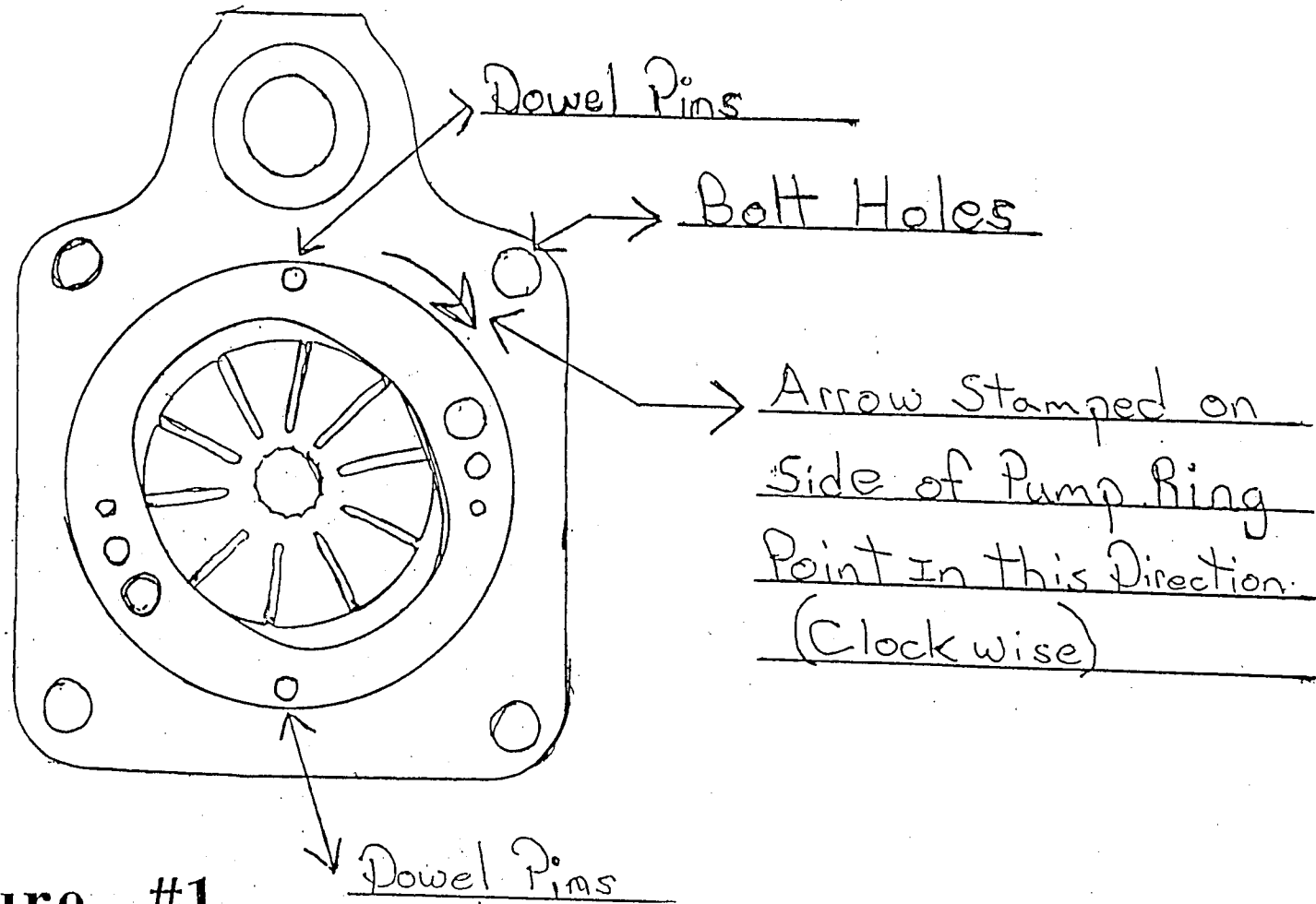
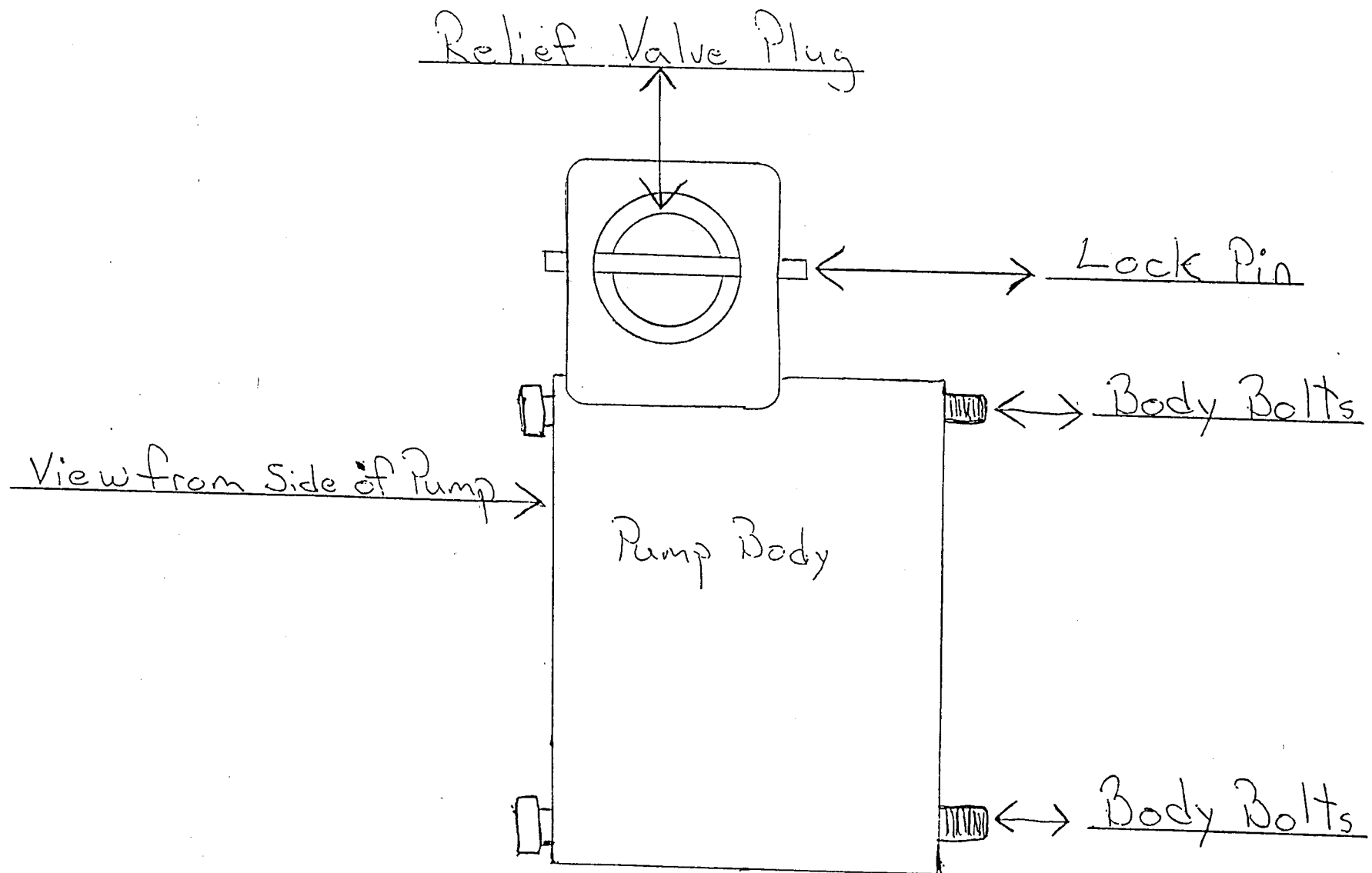


Figure #1

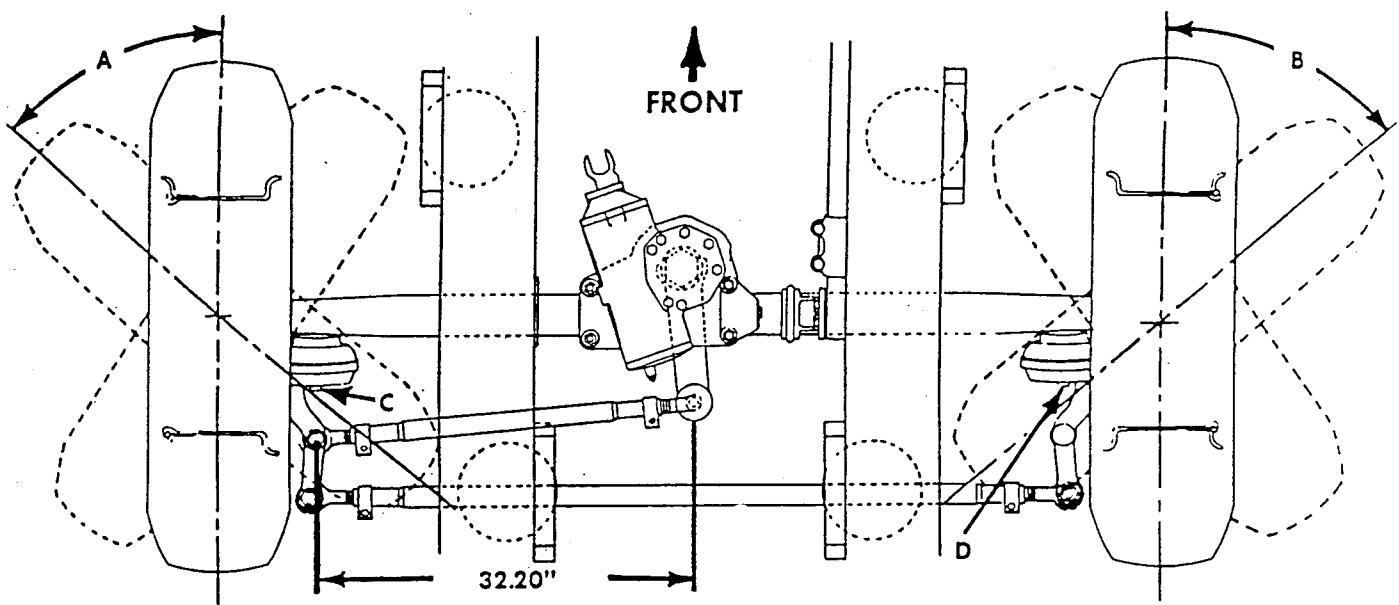
Figure #2

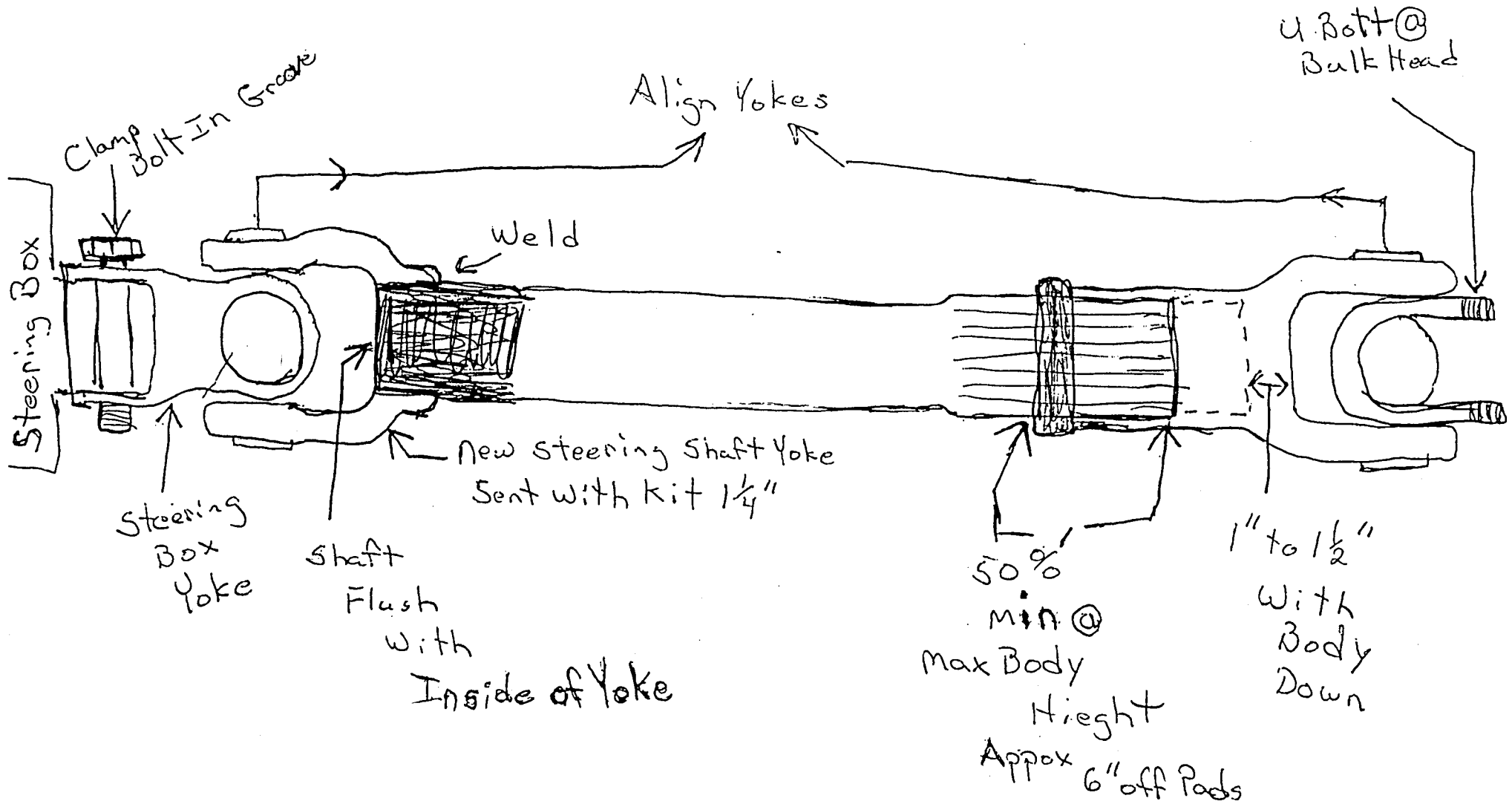


Library Facts Sheet

Figure #3

POWER STEERING





Library Facts Sheet

Figure #4

Library Facts Sheet

Figure #5&5A

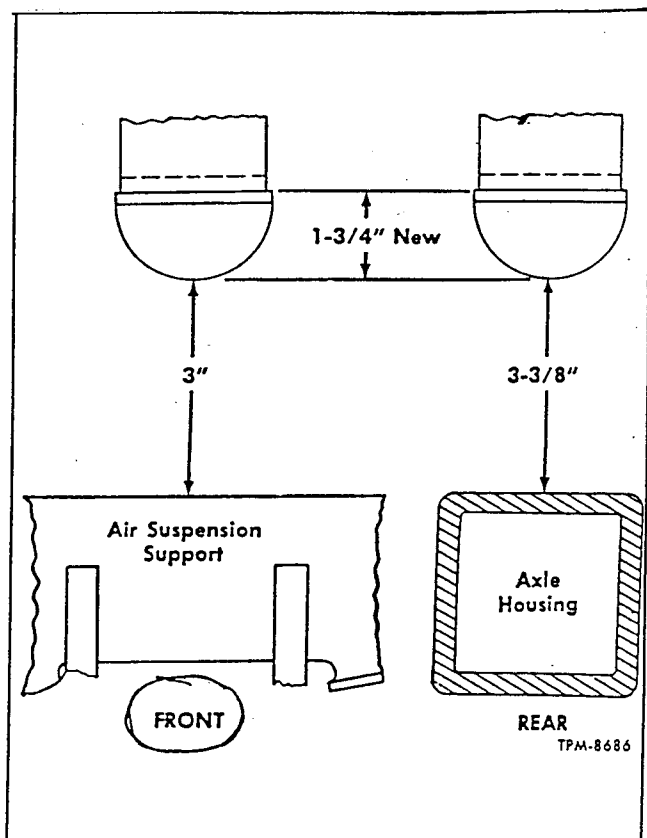


Figure 5—Normal Ride Height Clearance

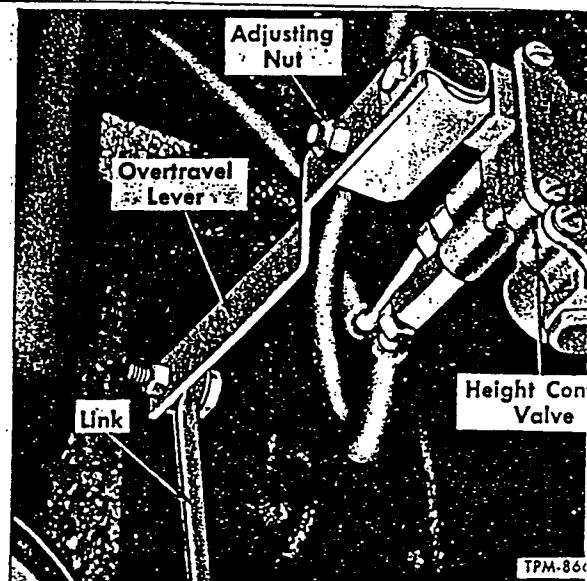
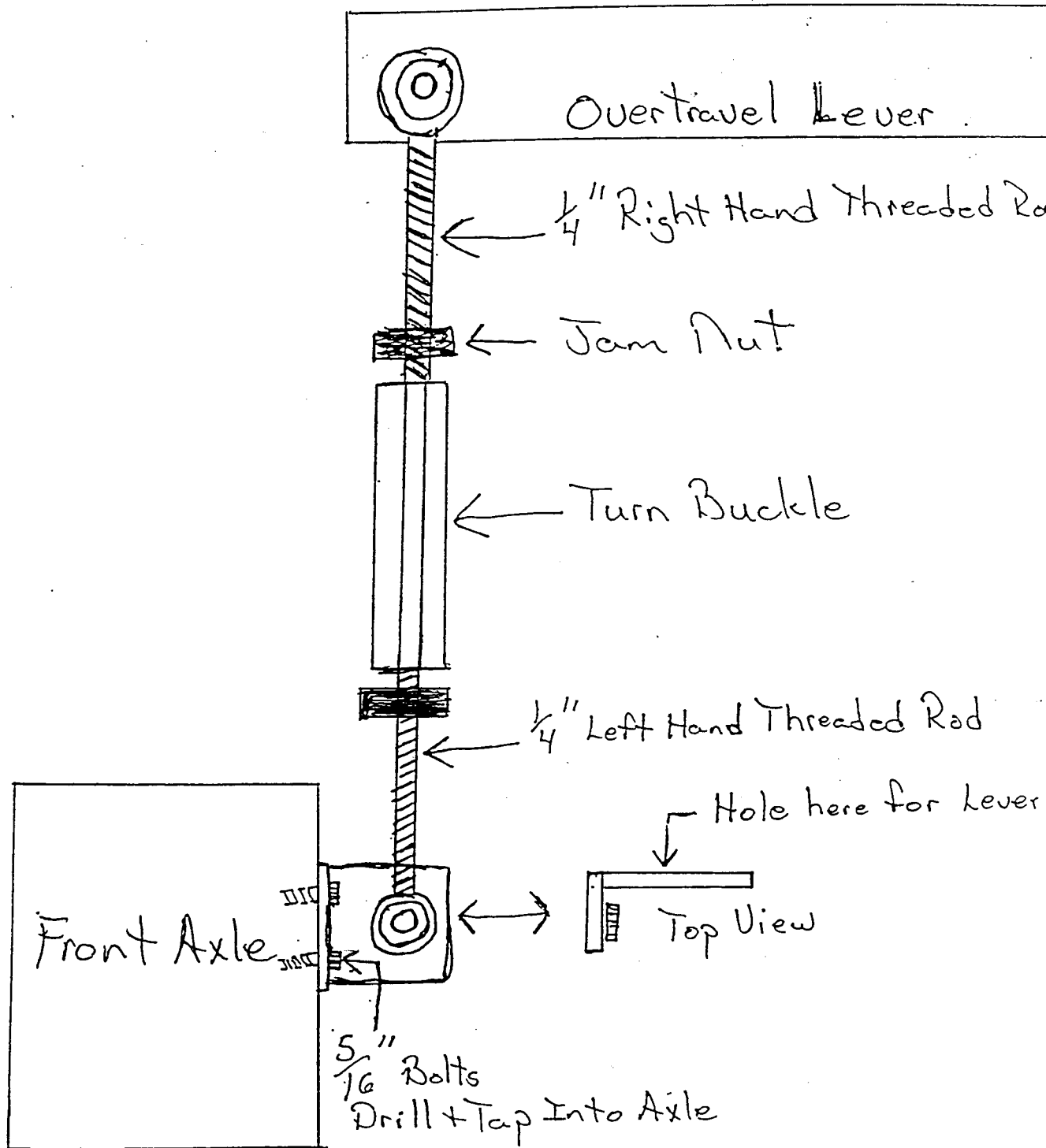


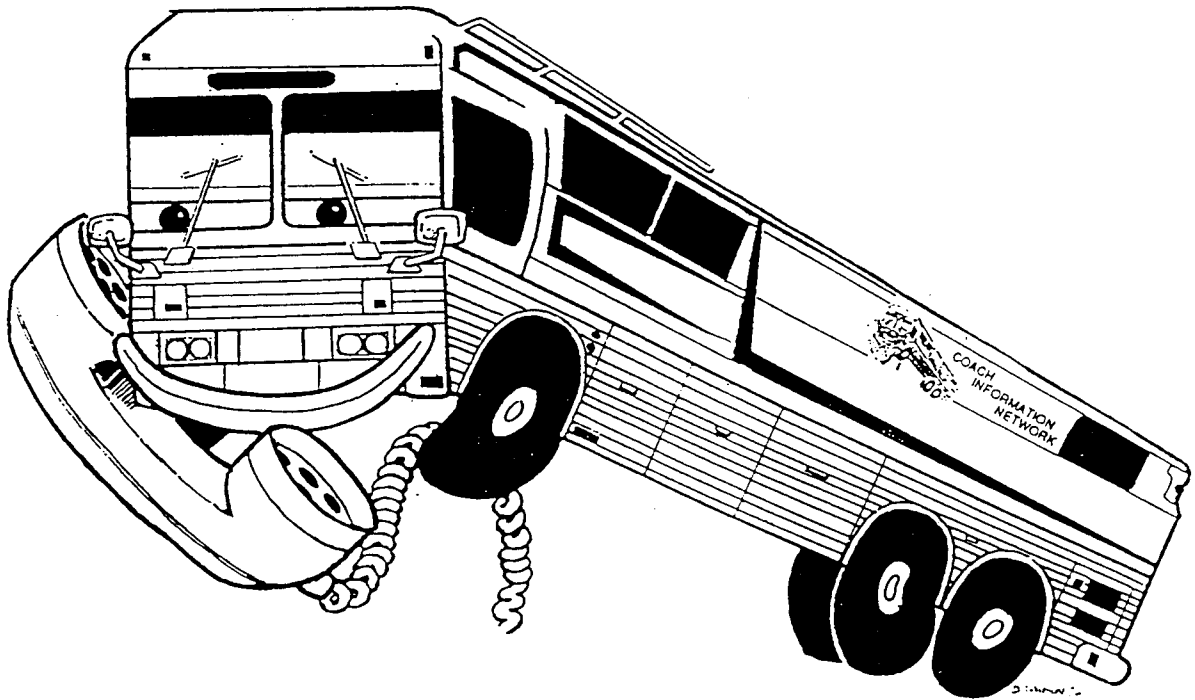
Figure 5A—Valve Overtravel Lever Adjustment

Library Facts Sheet

Figure #6



Item #7 Sheppard Steering Manufacturing Instruction Sheet

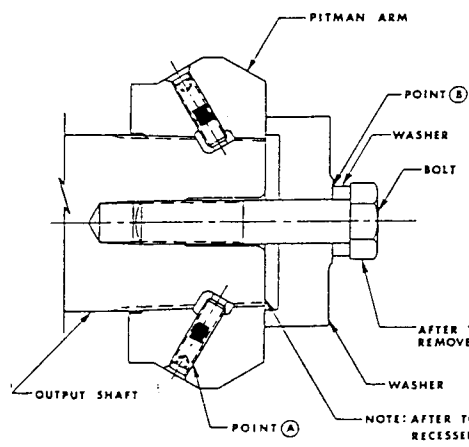
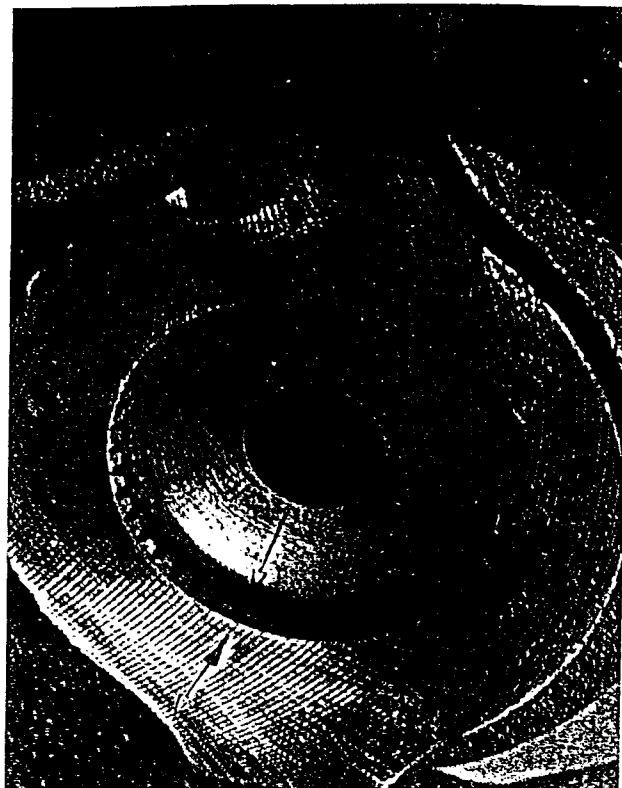


PITMAN ARM INSTALLATION INSTRUCTIONS

When the pitman arm is installed, the timing arrows on the arm and the output shafts must be aligned. If the pitman arm has two timing arrows marked "L" and "R" the same arm is used on both the master and the slave gear. The "L" arrow is used on the left or master gear and the "R" arrow is used on the right or slave gear.

The following charts detail the various pitman arm installation methods offered by The Sheppard Co.

Follow these procedures for the attachment method you are working with. Correct torque values are very important. Use the lubricant where indicated.

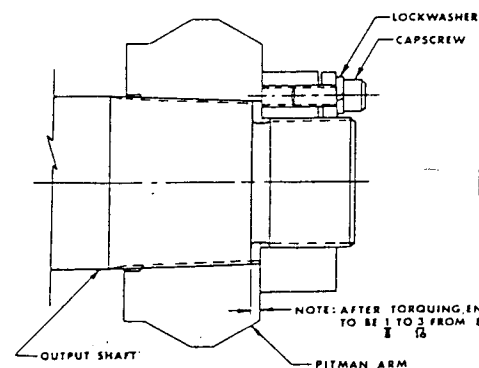


TORQUE SPECIFICATIONS				
MODEL NO.	WASHERS	BOLT NO.	TORQUE BOLT TO:	
292, 292 S-1	2261521	181441	85 FT. LBS.	115 N·M
392, 392 S	2261611	1/2-20 UNF X 2 3/4 LG GRADE 5		
492	2261571	181463	160 FT. LBS.	217 N·M
	2261621	9/16-18 UNF X 3 LG GRADE 5		
592	2261581	271591	170 FT. LBS.	230 N·M
	2261631	1/2-18 UNF X 3 LG GRADE 5		

USE LOX-CEASE, NEVER SEEZ OR WHITE LEAD ON THREADS OF SETSCREWS (POINT A) AND BETWEEN WASHERS (POINT B).

TORQUE SET SCREWS TO 12 TO 15 FT. LBS. (16 TO 20 N·M)

SET SCREWS - PART NO. 2420791
HEX SOCKET HEAD
HALF DOG WITH ALLEN
NYLOK SPOT LOK.
2 REQUIRED AND SUPPLIED
WITH PITMAN ARM



TORQUE SPECIFICATIONS			
MODEL NO.	CAPSCREW	TORQUE TO:	TORQUE NUT TO:
292, 392, 392 S	12 TO 15 FT. LBS.	16 TO 20 N·M	285 FT. LBS. 386 N·M
492	-	-	675 FT. LBS. 915 N·M
592	-	-	775 FT. LBS. 1050 N·M

USE LOX-CEASE, NEVER SEEZ OR WHITE LEAD BETWEEN PITMAN ARM AND NUT; IN THE THRS. OF THE NUT, AND ON THRS. OF THE OUTPUT SHAFT.

CAPSCREW - HEX. SOCKET HEAD
1/2-24 UNF X 3/4 LONG

SHEPPARD POWER STEERING

IMPORTANT INSTALLATION NOTES

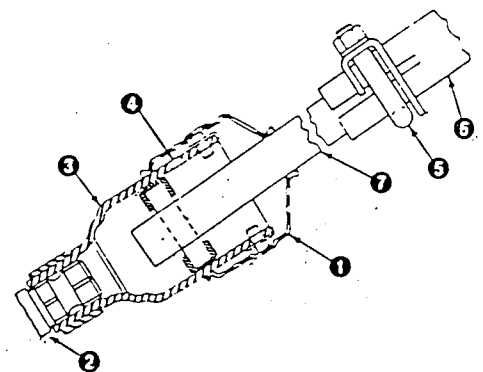
This Sheppard Integral Power Steering Gear has been manufactured, or remanufactured as the case may be, and tested prior to shipment. Every effort has been made to ensure that it will provide you with many miles of trouble free, safe operation.

To protect your investment and so as not to upset your warranty, it is important that these installation guidelines are followed:

1. Any time a power steering gear or power steering pump are replaced, the oil and oil filter should be replaced. All lines and fitting should be flushed or cleaned of any possible contaminants. Use 15W-40 motor oil or P/S fluid in Sheppard Steering Gears as specified by the manufacturer of your truck.
2. If a power steering pump has been replaced, it should be tested to ensure that its pressure and oil flow characteristics are the same as originally specified by the vehicle manufacturer.
3. When the steering gear is bolted to the frame rail or axle, care should be taken to ensure that the mounting bracket or steering gear is not distorted to a point where the piston will not move freely.
4. Install the steering shaft to the input shaft of the steering gear. (See flexible coupling attachment if equipped.)
5. If equipped with U-joint connection at steering gear input shaft, position the clamp bolt and torque to vehicle manufacturer specifications.
6. Bleed the steering gear(s) before the drag link is connected to be certain that the piston(s) travels its full stroke to displace any trapped air in the system. (See bleeding procedures following.)
7. Install the pitman arm correctly timed to the output shaft of the steering gear and torque properly. (See following pitman arm installation information.)
8. Adjust hydraulic relief plungers to provide proper clearance at the axle stops. (See procedures in following pages.)
9. Lube the grease fitting in the bearing cap (if provided) of the Sheppard Integral Power Steering Gear. Lube four times a year or as required. The power steering oil must be kept clean and free of foreign materials.
10. It is recommended that the power steering oil and oil filter be changed every 100,000 miles or once a year on over the highway trucks. Off highway trucks or vehicles, operating in dirty or abrasive conditions, will require more frequent change intervals.
11. Double-check all fasteners, fittings and hose routings before returning your vehicle to service.

Flexible Coupling Attachment (If Equipped)

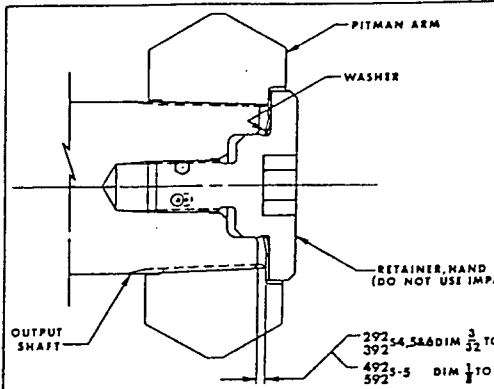
1. Attach the flexible coupling end of steering column to the steering gear, making sure the steering wheel is centered with the front wheels in the "straight ahead" position. The flexible coupling clamp bolt (2) must engage the bolt groove on the steering gear input shaft. Torque clamp nut and bolt to 30-35 ft. lbs.
2. Pull back protective rubber boot (1) so the gauge hole (4) in the coupling housing is accessible.
3. Loosen the u-bolt (5) on the hex tube upper column assembly to allow free axial movement at this joint.
4. Slide the lower steering shaft (7) all the way down (toward steering gear) until it bottoms out in the flexible coupling.
5. Insert a gauge pin of approximately 1/4 inch diameter into the gauge hole (4) of the flexible coupling.
6. Slide the lower steering shaft (7) up (toward firewall) until the flexible coupling contacts the gauge pin.
7. Tighten the u-bolt (5) at the hex tube clamp to 10-12 ft. lbs. Remove gauge pin. Replace the rubber boot to its original position over the coupling shell.



- | | |
|----------------------|------------------------|
| 1 RUBBER SEAL | 5 U-BOLT CLAMP |
| 2 HEX HD. SCREW | 6 UNIVERSAL JOINT TUBE |
| 3 COUPLING SHELL | 7 LOWER COLUMN |
| 4 ADJUSTING PIN HOLE | |

Steering Column Shell Coupling

PITMAN ARM INSTALLATION INSTRUCTIONS — CONT'D.



PITMAN ARM

WASHER

RETAINER, HAND TORQUE ONLY
(DO NOT USE IMPACT WRENCH)

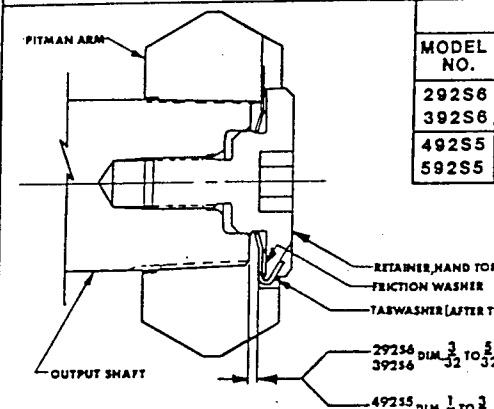
OUTPUT SHAFT

292S4, 392S4, 592S4 DIM $\frac{3}{32}$ TO $\frac{5}{32}$

492S5, 592S5 DIM $\frac{1}{8}$ TO $\frac{3}{16}$

TORQUE SPECIFICATIONS				
MODEL NO.	RETAINER NO.	WASHER NO.	TORQUE RETAINER TO:	
292S4, 392S4, 592S4	1790322	2261861	225 FT. LBS.	305 N·M
492S5, 592S5	1790312	2261851	450 FT. LBS.	610 N·M

USE LOK-CEASE, NEVER SEEZ OR WHITE LEAD BETWEEN PITMAN ARM AND RETAINER, IN THE THREADS OF THE OUTPUT SHAFT, AND ON THE THREADS OF THE RETAINER, AND ON BOTH SIDES OF THE WASHER!



PITMAN ARM

RETAINER, HAND TORQUE ONLY (DO NOT USE IMPACT WRENCH)

FRICTION WASHER

TAB WASHER (AFTER TIGHTENING RETAINER, BEND TABS INTO LOCKING POSITION AS SHOWN)

OUTPUT SHAFT

292S6, 392S6 DIM $\frac{3}{32}$ TO $\frac{5}{32}$

492S5, 592S5 DIM $\frac{1}{8}$ TO $\frac{3}{16}$

TORQUE SPECIFICATIONS				
MODEL NO.	RETAINER NO.	TAB WASHER NO.	FRICTION WASHER NO.	TORQUE RETAINER TO:
292S6, 392S6	1790422	2262121	2262021	225 FT. LBS. 305 N·M
492S5, 592S5	1790442	2262141	2262131	450 FT. LBS. 610 N·M

USE LOK-CEASE, NEVER SEEZ, OR WHITE LEAD BETWEEN PITMAN ARM AND RETAINER, IN THE THREADS OF THE OUTPUT SHAFT, AND ON THE THREADS OF THE RETAINER, AND ON BOTH SIDES OF THE FRICTION AND TAB WASHERS!

R. H. SHEPPARD CO. INC.

FINAL ADJUSTMENTS

Bleeding air from system

The steering gear by design is self bleeding; however, in some installations where the gear is positioned at an odd angle or where the piston does not make a full stroke in the cylinder bore can be trapped in the steering gear. To avoid this possibility the air should be bled from the system anytime the oil has been changed or the steering system is repaired.

After reinstalling the steering gear on the vehicle but prior to connecting the drag link to the pitman arm, bleed the air from the steering system in the following manner:

1. Fill pump reservoir with recommended oil. It will be necessary to continue filling after starting the engine and during the bleeding operation until correct oil level is maintained.

2. Set parking brake or block wheels. Start engine and allow it to operate at fast idle speed.
3. With engine running, turn steering wheel from left to right and return making three complete cycles to remove all air from the steering system.
4. Stop engine. Reconnect the drag link.

Following these procedures will ensure that the piston bottoms in both directions of steer, opens the relief valve in the piston, and allows the air to escape to the reservoir and into the atmosphere. (A)

Check and adjust the relief valve plungers as required.

Bleeding Air From System — Dual Steering

To bleed the air from the steering system on the vehicle after installing the steering gears, the pitman arms may be installed if there is no clearance problem with the pitman arm striking any object using the full travel of the gear. Install them by aligning the timing mark on output shaft with the timing mark on the pitman arm. For torquing see pitman arm torquing assembly. Then proceed in the following manner.

1. Fill pump reservoir with recommended engine oil. (Continue filling after starting engine and during the bleeding operation until correct oil level is maintained.)
2. Set parking brake. Start engine and allow it to operate at fast idle speed.
3. With engine running, drag links disconnected, turn steering wheel to the left and hold until the secondary (slave) gear pitman arm moves the full travel. Then turn to the right and hold until the secondary (slave) gear pitman arm again moves the full travel, repeat this process three or more times.
4. Connect the drag link to the master gear. Do not connect the secondary (slave) gear drag link at this time. Turn steering wheel to the left and hold until the secondary (slave) gear pitman arm moves the full travel. Then turn to the right and hold until the secondary (slave) gear pitman arm again moves the full travel. Repeat this process three or more times. Turn the steering wheel until the secondary (slave) gear pitman arm lines up with the drag link. Then install the pitman arm. (DO NOT move the pitman arm by hand or air will be pulled back into the system.)

Adjusting relief valve plungers

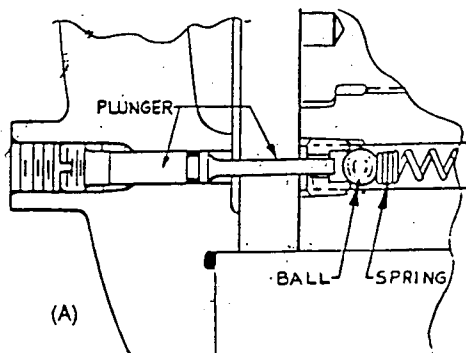
The relief valve plunger adjustment is provided to automatically reduce the steering pressure when the road wheels have reached their limits of turn. This keeps the supply pump from operating at maximum relief pressure when the road wheels are at their steering limits. System temperatures are therefore reduced and high stress loads on the mechanical components of the steering system are relieved.

CAUTION: Failure to adjust the plungers could result in power steering pump or steering gear damage.

High-pressure oil at either end of the piston will push the relief ball valve off its seat and fill the relief passage with oil at high pressure. At the opposite end of this passage the relief ball valve is held against its seat and holds the high pressure in the relief passage. As the piston moves close to its limits of stroke, the adjustable relief plungers push the relief ball valve off its seat and the pressure is relieved. The distance the piston can move is dependent upon the total front axle/steering system geometry and tire size. The relief valve plungers are adjustable to allow for variations or changes in these areas.

Adjust the relief valve plungers as follows:

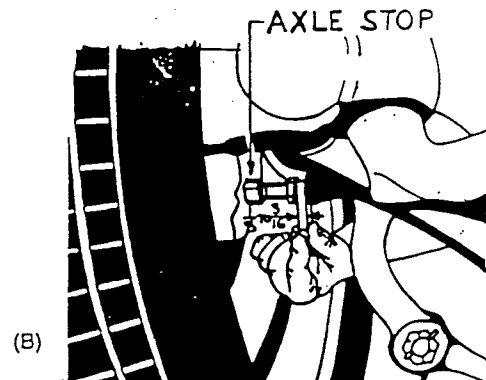
1. Start the engine and allow it to operate at idle speed.



2. With full weight of the vehicle on all wheels, turn the steering wheel in one direction until a high-pressure hiss is heard or the axle stops contact.
3. Turn the relief valve plunger (A) located on both ends of gear, in or out until the high-pressure hiss is heard when there is $\frac{1}{8}$ to $\frac{3}{16}$ inch clearance between the axle stops. (B)
4. Repeat this procedure for the opposite direction of steer, and adjust the relief valve plunger on the opposite end of the steering gear.

Turning the plungers in will increase the space between the axle stops. Turning the plungers out will decrease the clearance between the stops. Do not turn the slotted plungers out beyond flush with the plunger boss or a leak will occur. Axle stops should only be adjusted in accordance with the vehicle manufacturer's specifications.

After relief valve plunger adjustment always check to ensure that the road wheels and tires have adequate clearance between suspension, brake and frame components.



SECTION 16B

POWER STEERING

NOTE: For information on steering wheel, upper steering column, universal joint, lower steering column, bevel gear, and front and rear propeller shafts, refer to MECHANICAL STEERING (SEC. 16A) previously.

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Adjusting Turning Angle	16B-4
Steering Gear	16B-6
Steering Gear Replacement	16B-6
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CAUTION: All power steering components and attachments are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with parts of the same part numbers or with equivalent parts if replacement becomes necessary. Do not use replacement parts of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.

GENERAL

The power steering system (fig. 1) is standard on Model P8M-4905A and is available as optional equipment on Model P8M-4108A.

The power steering system consists of the steering wheel, steering column and bevel gear assembly, two steering propeller shafts and support, power steering gear assembly, a vane type hydraulic pump, reservoir, filter, and allied parts of the front axle.

Items that affect steering and tire wear are: Air Suspension, Brakes, Wheel Bearings, Front Axle, and Front End Alignment. These items are covered in their respective sections of this manual.

The power steering gear (fig. 2) is mounted on the front axle and is connected to the steering column bevel gear unit by two propeller shafts (fig. 1). The power steering gear contains an integral power cylinder and control valve in the gear housing.

OPERATION

Power steering is accomplished by hydraulic pressure. Steering fluid is supplied by a vane-type hydraulic pump mounted at right rear of the engine and driven through a coupling by the engine blower drive shaft. Hydraulic fluid lines (fig. 3) are routed from the power steering reservoir to the pump. Fluid displaced by the pump is circulated through flexible fluid lines to a filter mounted on the engine compartment bulkhead then to the

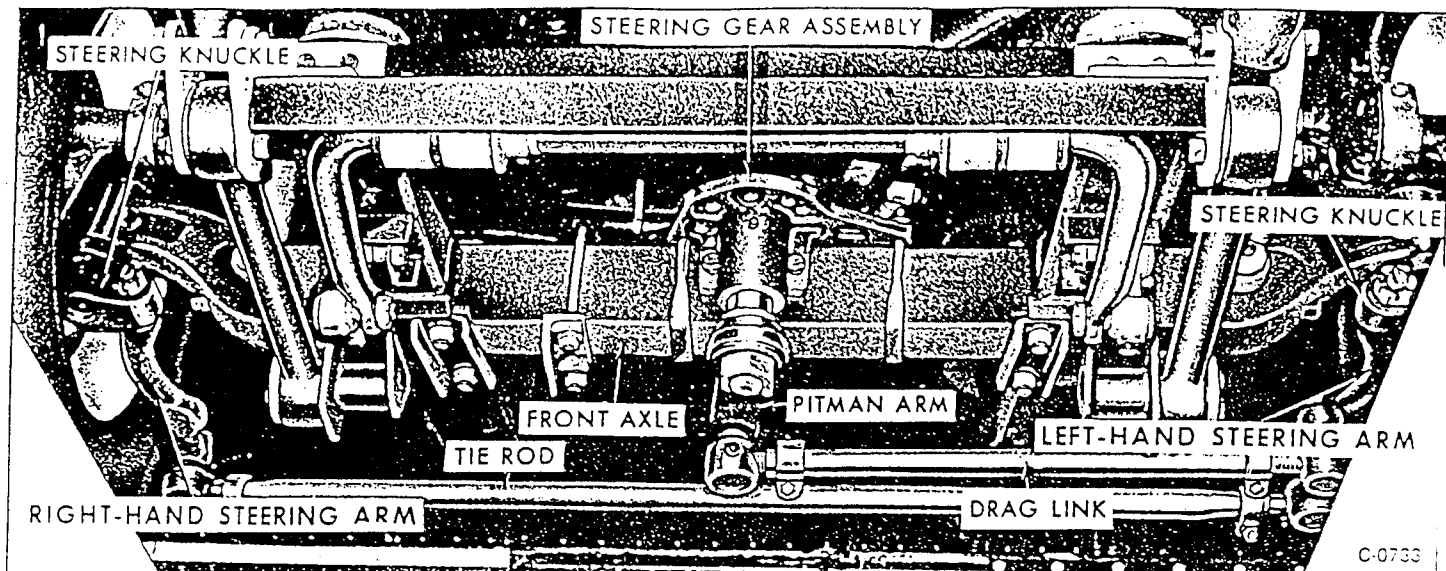


Figure 1 - Power Steering System

power steering gear mounted on the front axle center. A return line is connected from the steering gear back to the reservoir.

There are four basic operating parts within the power steering gear assembly: The actuating shaft, actuating valve, piston, and output shaft and pinion gear assembly (fig. 4).

When steering wheel is turned, the propeller shafts turn the power steering gear actuating shaft. The actuating valve within the piston moves on the threaded actuating shaft when the shaft is turned. Two ports on outside diameter of the valve (fig. 5) direct oil flow into the piston. The ports seal against mating edges inside the piston to direct oil flow to either end of the piston. One side of the piston rack engages the pinion gear on the output shaft. When the piston moves back and forth within the housing, the gear turns to provide the rotating action of the Pitman arm connected to the steering drag link.

When wheels are turned to either extreme position, relief valve plungers (adjustable stops) at bearing cap and cylinder head automatically unload the hydraulic system to protect the mechanism from undue strain and damage.

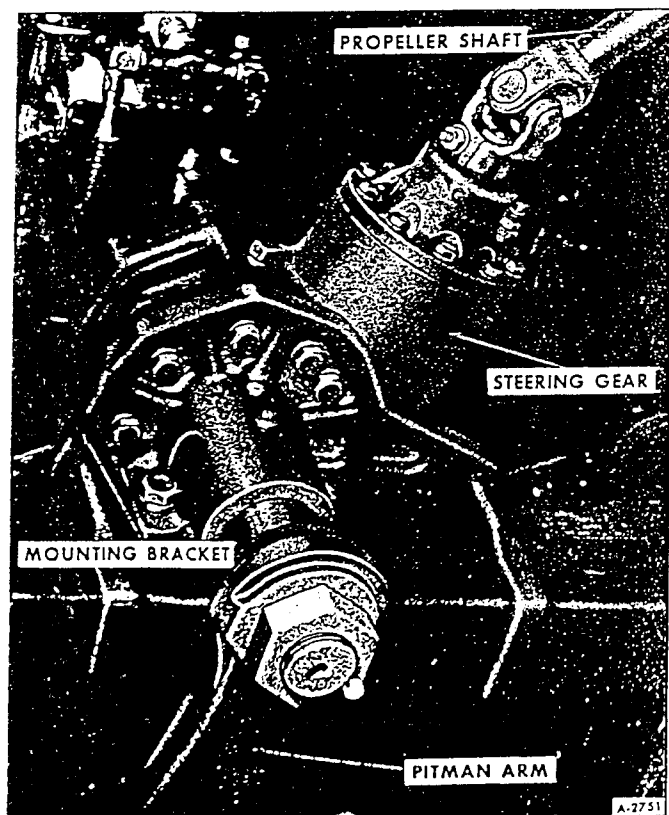


Figure 2 - Power Steering Gear Installed

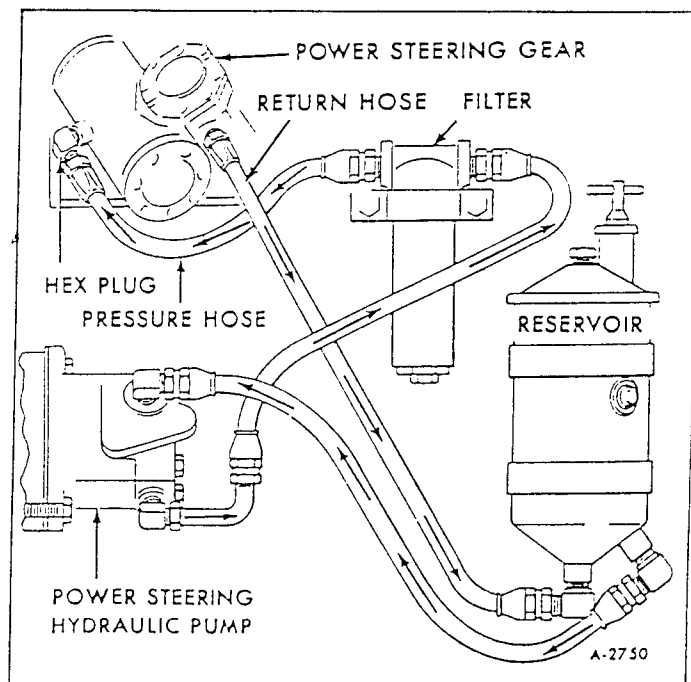


Figure 3 - Power Steering Hydraulic System

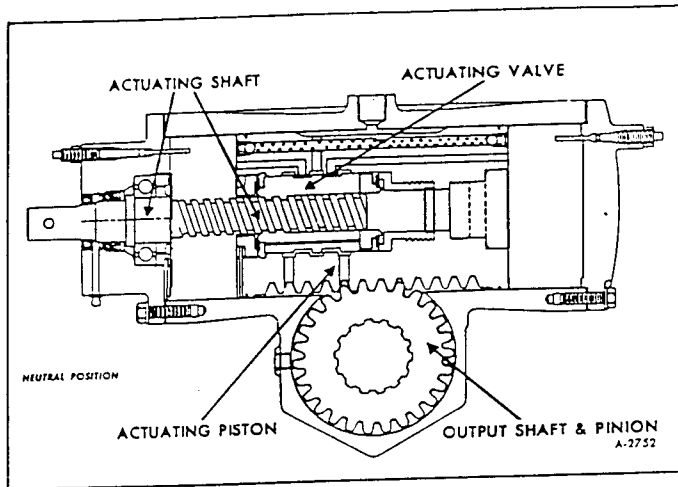


Figure 4 - Sectional View of Steering Gear

The power steering hydraulic system has a double filtering action to ensure that foreign matter does not enter the pump or steering gear. A filter in the reservoir filters fluid before it enters the pump and a supply line filter is used to filter the fluid before it enters the steering gear.

MAINTENANCE AND INSPECTION

PERIODIC MAINTENANCE AND INSPECTION

The power steering system must be kept clean to insure maximum operating performance. The following maintenance operations include inspection and adjustment items which may be accomplished without removing the steering gear from the vehicle.

1. Periodically inspect system for leaks and correct any abnormal conditions.

2. At regular intervals, check and if necessary, tighten all steering gear mounting bolts, bevel gear housing mounting bolts, propeller shaft yoke bolts, Pitman arm retaining nut, drag link to Pitman arm retaining nut, drag link to Pitman arm and steering arm stud nuts, tie rod to steering arm stud nuts, drag link and tie rod clamp bolts nuts, and all assembly bolts on steering gear and bevel gear housing.

3. Check fluid level in pump reservoir and add fluid when required. Refer to LUBRICATION (SEC. 13) in this manual for type of fluid to be used, method, and intervals for filling.

4. Check fluid reservoir and filter mounted in right hand corner of engine compartment for evidence of dirt, sludge, or water. When the slightest evidence of dirt, sludge, or water is found in the system, disconnect fluid lines at power steering gear. Drain and refill system with clean recommended fluid.

5. Service power steering fluid filters at regular lubrication intervals. Refer to instructions under "Power Steering Fluid Reservoir and Filter" later in this section.

6. Check operation of the system. Air in the fluid system will cause spongy action and noisy operation. When any hose has been disconnected or when fluid has been lost for any reason, the system must be bled after adding fluid. Bleed the system as directed later in this

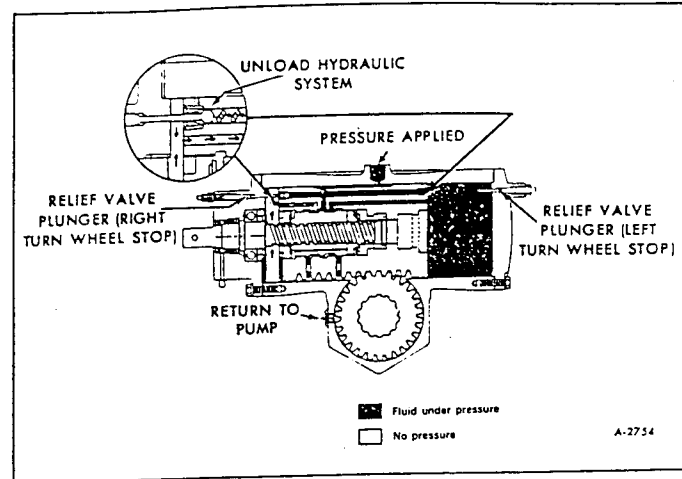


Figure 5 - Power Steering Gear Operation

section under "Bleeding Power Steering Hydraulic System."

7. Should the power steering system become inoperative because of loss of hydraulic fluid, re-route pump pressure line from pump outlet directly back to pump reservoir.

NOTE: DO NOT operate pump without fluid in the pump reservoir.

8. Check linkage between steering gear and front wheels. If linkage is out of adjustment, bent, twisted, or worn, steering will be seriously affected. Whenever any steering linkage parts are repaired, replaced, or adjusted, steering geometry and front wheel alignment must be checked. Refer to FRONT AXLE (SEC. 1) in this manual.

9. At regular lubrication intervals, thoroughly check steering linkage for worn or loose ball stud end sockets.

HIGH MILEAGE MAINTENANCE AND INSPECTION

NOTE: After the coach has operated continuously and high mileage figures have been reached, overhaul of the various units will be required. General overhaul procedure normally requires the removal of the entire assembly, cleaning and inspection of all parts and final assembly. Careful inspection of all parts during overhaul is a very important item and must not be neglected.

It is recommended that after approximately 150,000 miles or five years of service, the entire steering system be given a thorough inspection and complete overhaul. It is recommended that all original parts which are to be used again be Magnaflux or Magnaglo inspected. This type of inspection should also be performed in cases where an operator purchases a used coach.

Steering parts, such as the Pitman arm and drag link, are often difficult to remove and where the proper type of pullers are not used, a shock method is used to drive parts loose with heavy hammers. In no instance should heat be applied to these parts in the effort to disassemble them as

damage could result. All of these conditions will affect the entire steering assembly and therefore, periodic maintenance must be thorough and regular.

BLEEDING POWER STEERING HYDRAULIC SYSTEM

When power steering hydraulic pump, power steering gear assembly, or fluid reservoir and filter assembly has been removed for overhaul or replacement, or any hydraulic system lines have been disconnected, the hydraulic system must be bled before vehicle is again operated. Bleed power steering hydraulic system as follows:

NOTE: When adding hydraulic fluid to the power steering system, secure a 200 mesh wire screen inside a funnel and pour fluid through the screen. Use only hydraulic fluid recommended in LUBRICATION (SEC. 13) of this manual in power steering hydraulic system.

1. Fill power steering pump reservoir tank to "FULL" mark on dipstick. Let fluid remain undisturbed for two or three minutes.
2. Raise front end of coach until front wheels are off the floor.
3. Eliminate air pockets in power steering gear and hydraulic system by turning front wheels to right and left wheel stops. Continue this procedure while maintaining fluid level in reservoir to "FULL" mark on dipstick until fluid in reservoir stops bubbling.
4. Start engine and run at idle for two or three minutes. Turn front wheels to right and left as before. **DO NOT HIT WHEEL STOPS.** Maintain fluid level in pump reservoir to "FULL" mark on dipstick. Check system lines and connections for leaks. Continue these procedures until fluid in reservoir is clear and free of bubbles.

5. Increase engine speed to approximately half throttle and run engine at this speed until all signs of air bubbles cease to exist in reservoir. Turn wheels to right and left as before. **DO NOT HIT WHEEL STOPS.**

6. Lower coach to floor and turn wheels to right and left while rechecking for fluid leaks.

7. Recheck fluid level in reservoir and fill to "FULL" mark on dipstick.

HYDRAULIC PRESSURE TEST

1. Disconnect pressure hose from fitting at the hydraulic pump.

NOTE: Some hydraulic fluid will leak out when line is disconnected. Provision should be made to catch this drainage.

2. Connect pressure checking gage (J-5631-02) (fig. 6) between the pump pressure line and power steering fluid filter. Leave valve in pressure gage line open.

3. Bleed steering hydraulic system to remove all air from pressure line as directed previously under "Bleeding Hydraulic System."

4. Start engine and run at idle speed. Turn wheels through normal operating range several times until the hydraulic fluid temperature reaches 170°F. When fluid temperature reaches 170°F, close valve in pressure gage line and observe reading on pressure gage. Pressure reading should be 1450 to 1550 psi.

NOTE: DO NOT leave valve closed for more than 15 seconds.

5. Open valve in pressure gage line. Turn wheels to extreme right and left against "stops" (with wheels on ground). At extreme right or left position maximum pressure reading should be within amount specified in step 4.

6. If pump pressure is less than amount specified, make necessary repairs described under "Hydraulic Pump Overhaul" later in this section.

7. If pump pressure is satisfactory, shut off the engine and remove pressure checking gage.

8. Reconnect pressure hose to steering fluid filter; then bleed hydraulic system as described previously under "Bleeding Power Steering Hydraulic System."

ADJUSTING TURNING ANGLE

NOTE: Refer to figure 7.

The turning angle is the maximum angle through which the wheels may be turned from straight-ahead position. This angle is greater for the inside wheel than the outside wheel on a turn. Before adjusting turning angle, be sure front end is properly aligned as described in FRONT END ALIGNMENT (SEC. 1) of this manual.

Relief valve plungers at both ends of the power steering gear assembly limit the wheels from turning beyond the desired angle. Wheel stops on the axle limit stop wheel turning angle in event relief valve plungers are not properly adjusted.

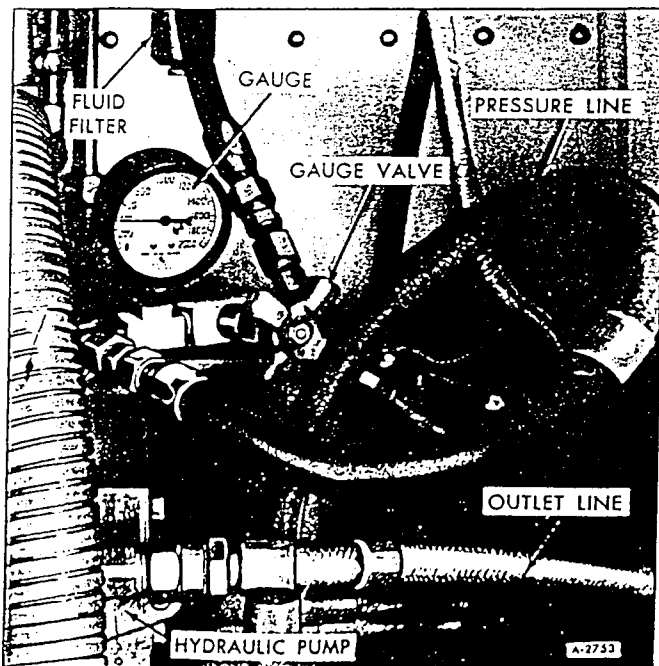


Figure 6 - Checking Pump Hydraulic Pressure

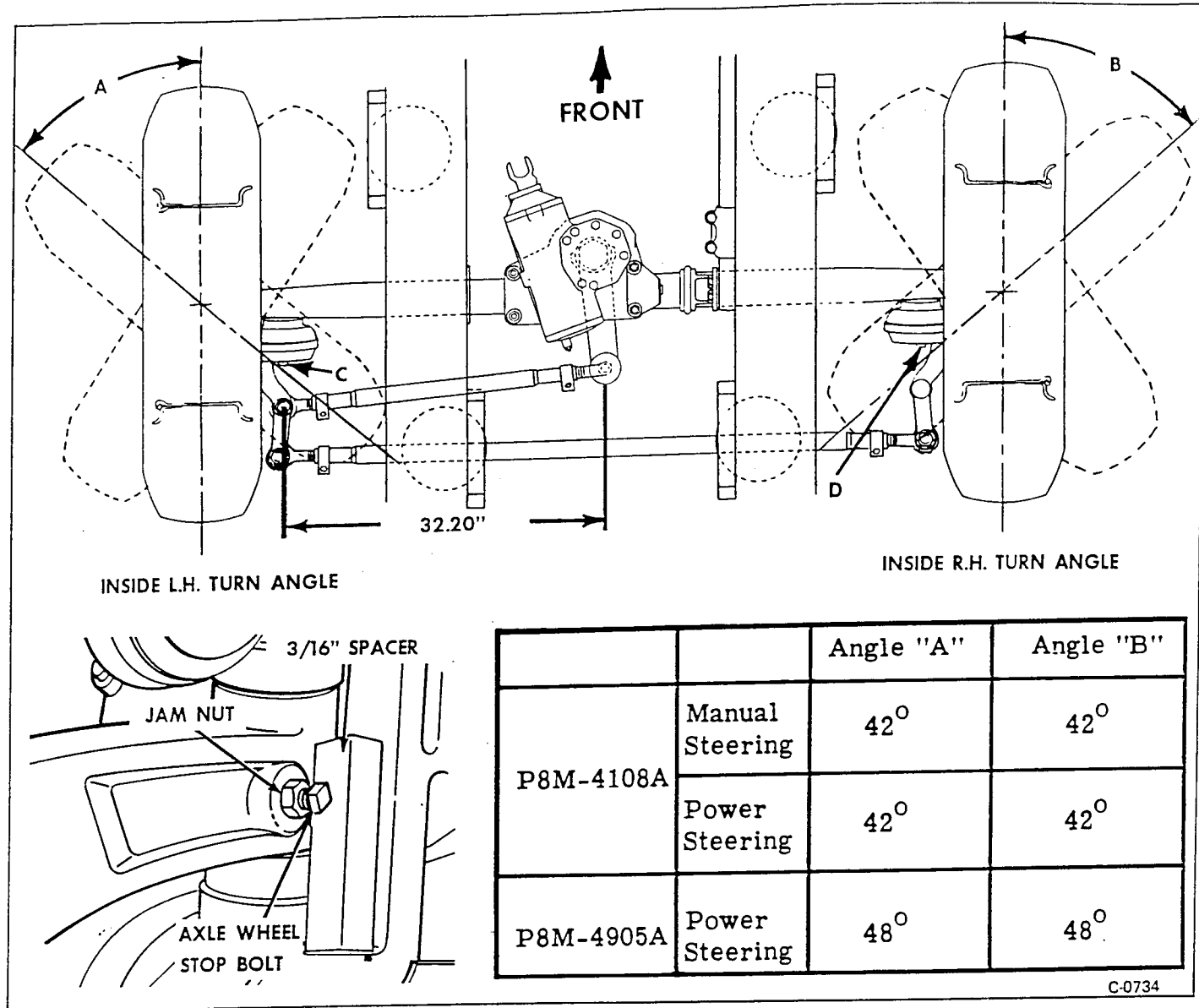


Figure 7 - Turning Angle Adjustment

NOTE: Right- and left-hand inside turning angles are shown in figure 7. Use an accurate turning angle instrument to make correct angular measurements.

1. Install a 3/16-inch spacer between left steering knuckle and wheel stop bolt. Adjust position of left wheel to angle "A" (maximum left turn position). Loosen jam nut and turn stop bolt "C" to just contact spacer. Tighten jam nut.

2. Install pressure gage (J-5631-02) at tee on steering gear. Turn wheels to left until stop bolt contacts spacer. Adjust plunger at rear cylinder cap until gage reads 250-300 psi (100 foot-pounds torque must be applied at input to steering gear).

3. Install a 3/16-inch spacer between right steering knuckle and wheel stop bolt. Adjust position of right wheel to angle "B" (maximum right turn position). Loosen jam nut and turn stop bolt "D" to just contact spacer. Tighten jam nut.

4. Install pressure gage at tee on steering gear. Turn wheels to right until stop bolt contacts spacer. Adjust plunger at front cylinder cap until gage reads 250-300 psi (100 foot-pounds torque must be applied at input to steering gear).

5. Turn wheels to right and left until stopped by power steering gear stops. Check for 1/8- to 3/16-inch clearance between axle wheel stop bolt and king pin housing.

POWER STEERING GEAR

REPLACEMENT

REMOVAL (Fig. 8)

1. Position a suitable spacer between axle bump stop and support beam to maintain coach ride height when leveling valve link and support bracket are removed from the front axle.
2. Disconnect power steering gear return line and supply line and allow fluid to drain into a suitable container. Plug open end of lines to prevent foreign matter from entering the system.
3. Remove cotter pin and nut from drag link to Pitman arm stud nut then remove drag link.
4. Remove four nuts from power steering gear to axle support U-bolt and remove support U-bolts from mounting bracket.
5. Remove two power steering gear to axle bolts. Remove steering rear prop shaft to actuating shaft clamp bolt and nut.
6. Support weight of steering gear and move straight forward to remove from axle.

INSTALLATION (Fig. 8)

NOTE: Align timing mark on steering gear output shaft with timing mark on Pitman arm. Install Pitman arm to shaft with locknut, washer, and lock screw. Adjust drag link to 32.20 inches from centerline of stud to centerline of stud and attach to steering arm stud and Pitman arm stud.

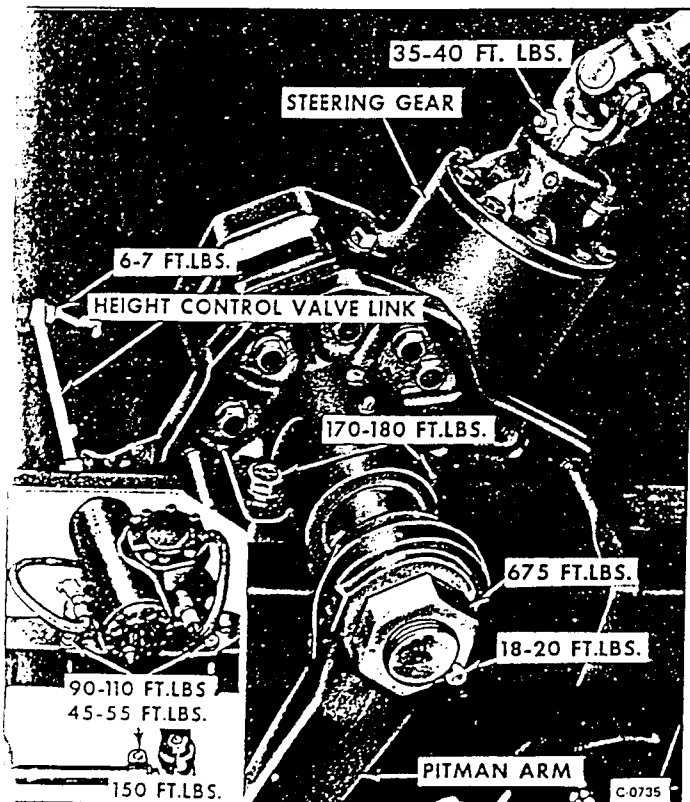


Figure 8 - Power Steering Gear Mounting

1. Align steering gear housing with mounting holes in axle center. Install two mounting bolts with hard steel washers and tighten bolts to 170-180 foot-pounds torque.
2. Support steering gear assembly on front axle and connect rear steering prop shaft to steering gear actuating shaft.
3. Install prop shaft to actuating shaft clamp bolt with flat washer and nut. Tighten nut to 25-30 foot-pounds torque.
4. Install power steering gear mounting bracket to axle support clips and attaching nuts. Tighten nuts to 90-110 foot-pounds torque.
5. If Pitman arm was removed, apply a bead of caulking around shaft at top of Pitman arm. Apply white lead between Pitman arm and nut, in threads of output shaft, and in threads of nuts. Position Pitman arm on shaft with alignment marks matched. Tighten Pitman arm nut to 675 foot-pounds torque. Install socket head cap screw and tighten to 18-20 foot-pounds torque.
6. Connect drag link to Pitman arm and tighten stud nut to 150 foot-pounds torque. Advance nut to next aligning cotter pin slot and install a new cotter pin.
7. Remove protective caps from power steering gear supply line and return line and connect lines to steering gear.
8. Connect height control valve link to mounting bracket then raise coach ride height and remove spacer from axle bump stops.
9. Fill power steering reservoir to "FULL" mark on dipstick with fluid specified in LUBRICATION (SEC. 13) of this manual and bleed hydraulic system as directed under "Bleeding Power Steering Hydraulic System" earlier in this section.

STEERING GEAR OVERHAUL DISASSEMBLY

NOTE: When disassembling or assembling the power steering gear, cleanliness is of utmost importance. Dirt or foreign particles will impede proper operation of the unit. Power steering gear components are shown in figure 9.

1. Remove steering gear as directed previously in this section.
2. Mount steering gear assembly in a vise or holding fixture with actuating shaft horizontal. Do not grip the housing too tightly in vise.
3. Loosen jam nut on relief valve plunger and remove plunger from both ends of power steering gear (fig. 10).
4. Remove socket head capscrew from Pitman arm to shaft nut using an Allen wrench; then remove shaft nut.
5. Remove Pitman shaft housing cover bolts (fig. 11). Use a soft hammer and tap on end of output shaft to loosen cover. The output shaft and pinion gear assembly may be removed with the cover.

NOTE: Observe timing mark on rack located on center tooth of piston. This mark must be aligned with timing mark on pinion gear when output shaft is installed.

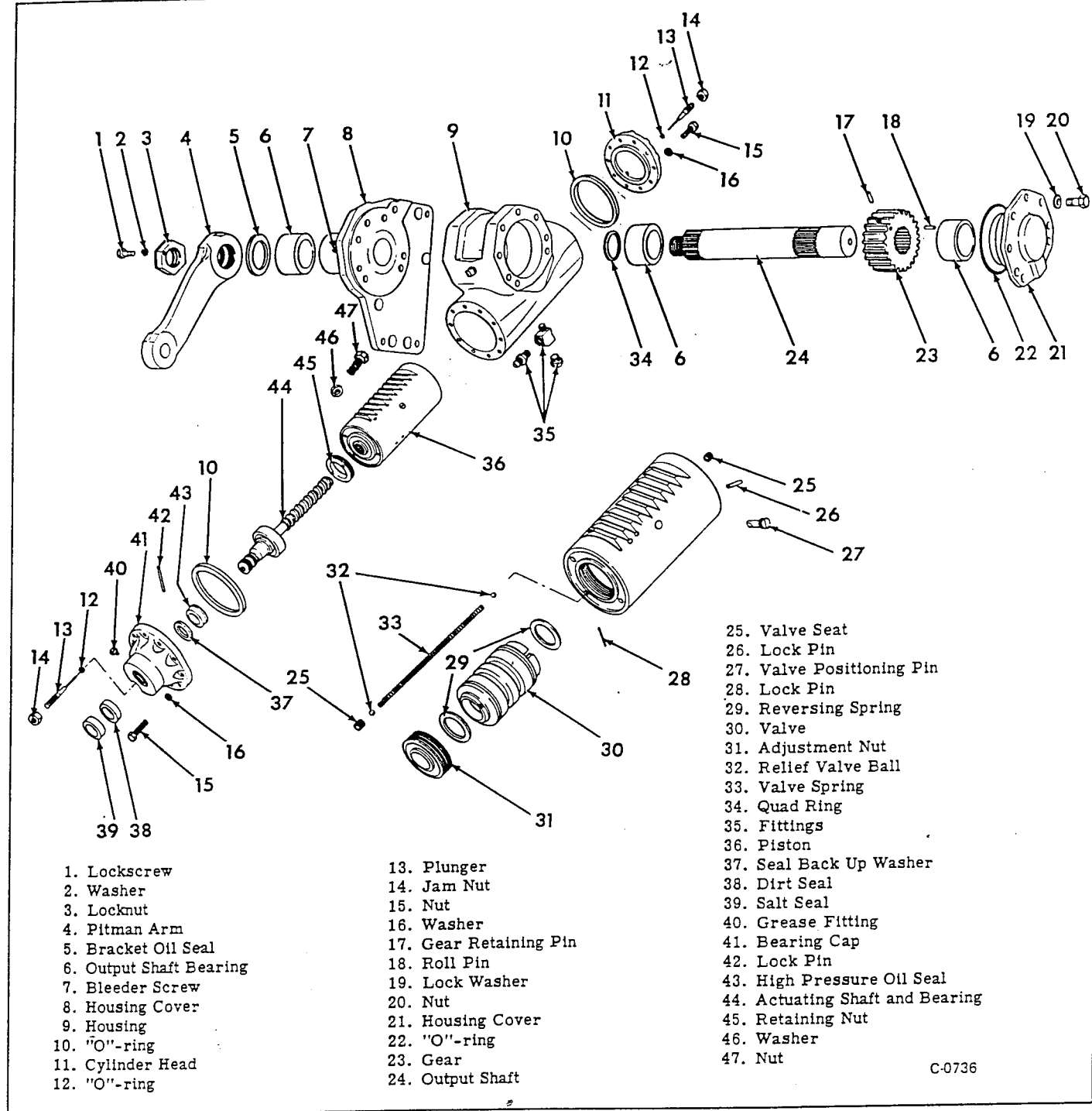


Figure 9 - Power Steering Gear Components

6. If output shaft and pinion gear assembly was not removed with the cover, lift assembly from housing (fig. 12).

7. To remove pinion gear from output shaft, remove roll pin and gear retaining pin, then carefully press output shaft (pinion) gear from shaft (fig. 13).

8. Scribe alignment marks on cylinder head, bearing cap and gear housing to assure proper alignment when assembling parts.

9. Remove bolts from cylinder head then remove cylinder head and gasket from housing (fig. 14).

10. Remove bolts from bearing cap and turn actuating shaft and bearing cap out of actuating valve (fig. 15).

11. Remove lock pin from bearing retaining nut (fig. 16).

12. Use a spanner wrench to loosen bearing retainer nut. Remove retainer nut (fig. 17).

13. Press actuating shaft and bearing assembly out of bearing cap (fig. 18).

NOTE: Do not attempt to remove bearing from actuating shaft. They are serviced only as an assembly.

14. Using a piece of 1½-inch round stock, 2-inches long and turned to a diameter of 1.490, press high pressure

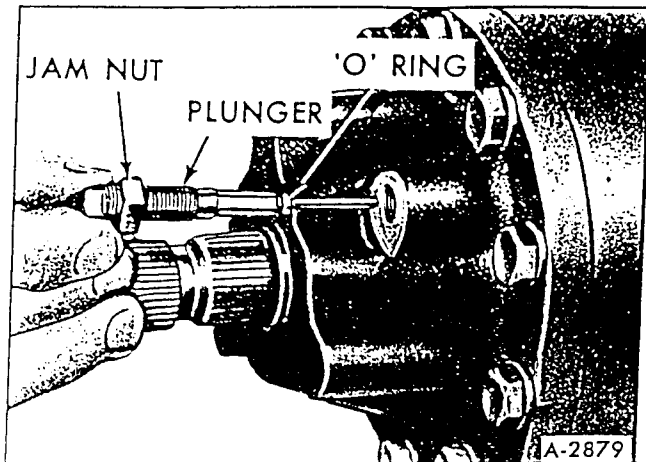


Figure 10 – Removing Relief Valve Plunger (Typical)

oil seal, seal back-up washer, dirt seal, and salt seal out of bearing cap from direction shown in figure 19.

15. Pull piston assembly from gear housing (fig. 20).

NOTE: DO NOT disassemble the actuating piston assembly unless absolutely necessary. Refer to "Actuating Piston Overhaul" later in this section.

16. Remove seal (quad ring) from output shaft bore of housing (fig. 21).

17. If bushings in gear housing or cover are worn or otherwise damaged, use a suitable puller to remove the bushings.

ACTUATING PISTON OVERHAUL

NOTE: Before disassembling the actuating piston, refer to troubleshooting guide at end of this section to assure trouble is in the piston and not some other unit.

1. Place reference marks on piston and adjustment nut to assure parts are assembled in exactly the same position (fig. 22). Remove locking pin from valve adjusting nut.

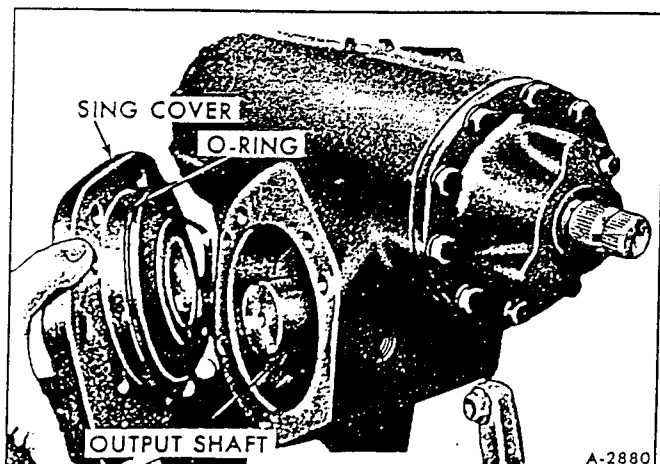


Figure 11 – Removing Housing Cover (Typical)

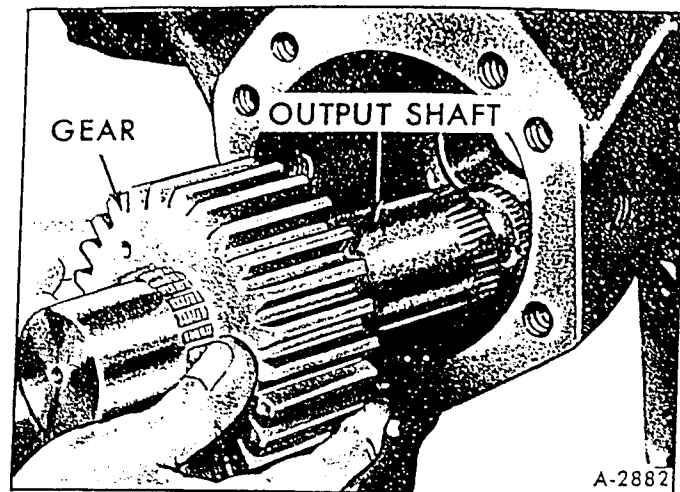


Figure 12 – Removing Output Shaft and Gear (Typical)

2. Remove valve adjusting nut from piston (fig. 23).

3. Lift reversing spring from actuating valve (fig. 24).

4. Pull actuating valve from piston (fig. 25). DO NOT force valve out of piston.

5. Use a screwdriver to remove valve positioning pin from piston (fig. 26).

6. Remove remaining reversing spring from piston. Remove valve seat using a 3/16-inch Allen wrench (fig. 27).

7. Carefully inspect parts for wear or damage and replace parts found not to be in good condition. Check for burrs or nicks on or near the piston rack. If there is a raised burr on the piston, use a fine hand stone to remove it.

8. Position relief valve spring and one relief valve ball into the valve bore. Use a 3/16-inch Allen wrench to install one of the valve seats (fig. 27).

NOTE: The valve seats must be tight and flush with or slightly below end surface of piston.

9. Install second relief valve ball seat in the same manner.

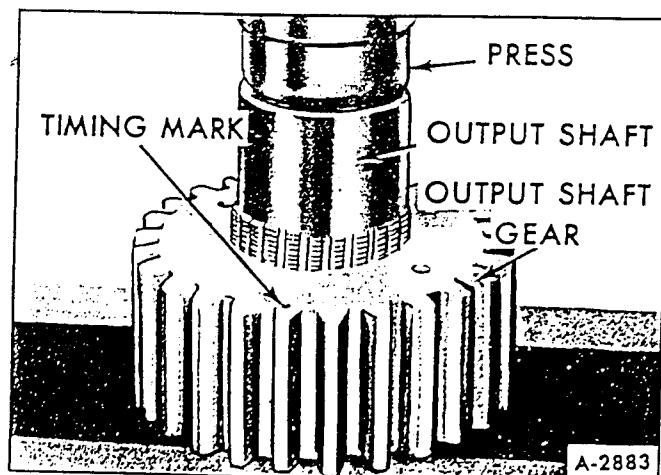


Figure 13 – Removing Output Shaft from Gear (Typical)

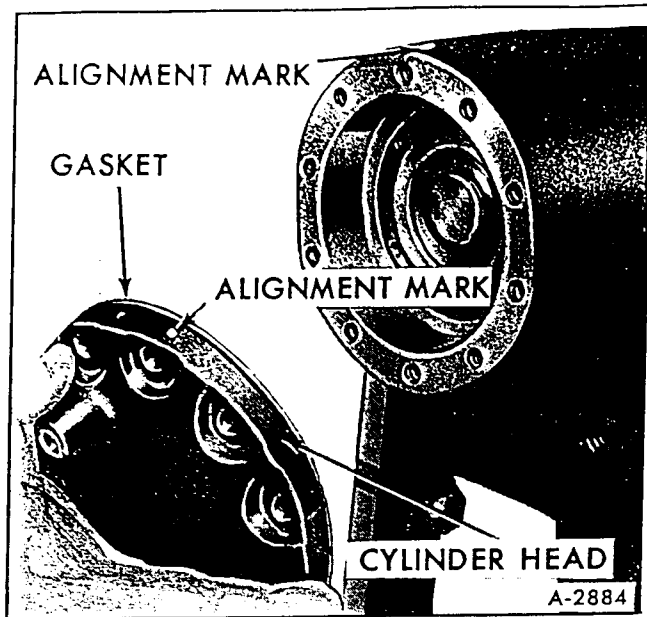


Figure 14 – Removing Cylinder Head (Typical)

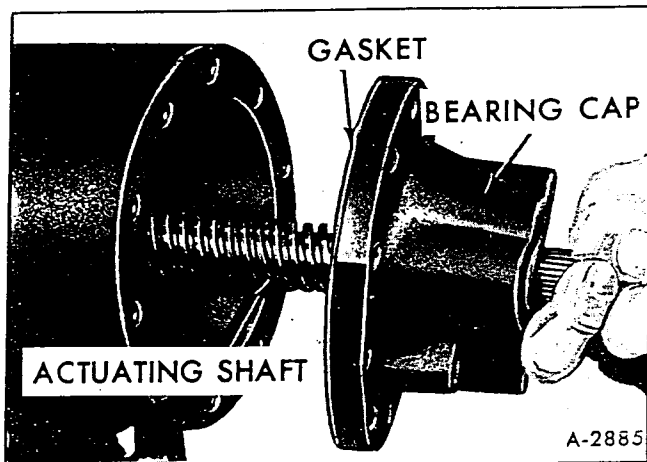


Figure 15 – Removing Actuating Shaft and Bearing Cap

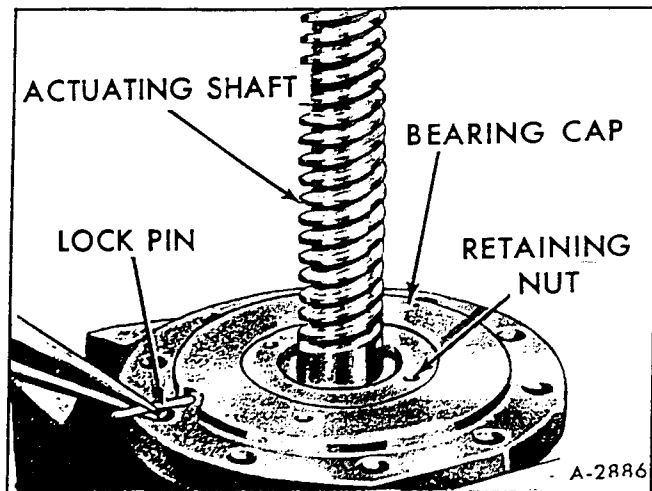


Figure 16 – Removing Lock Pin from Bearing Retainer Nut

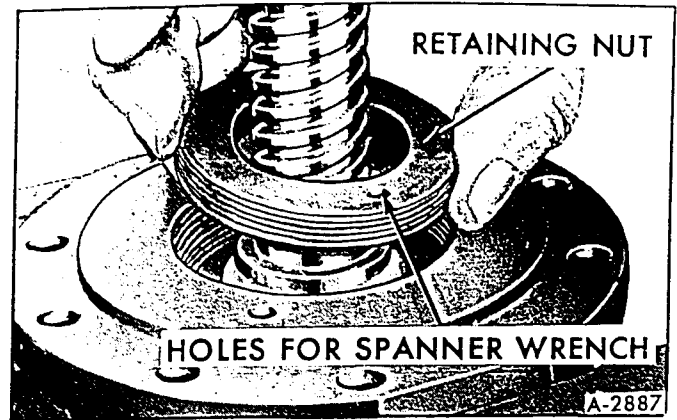


Figure 17 – Removing Bearing Retainer Nut

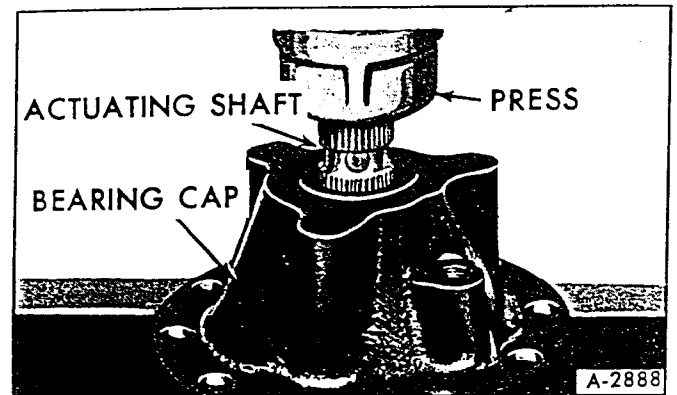


Figure 18 – Removing Actuating Shaft

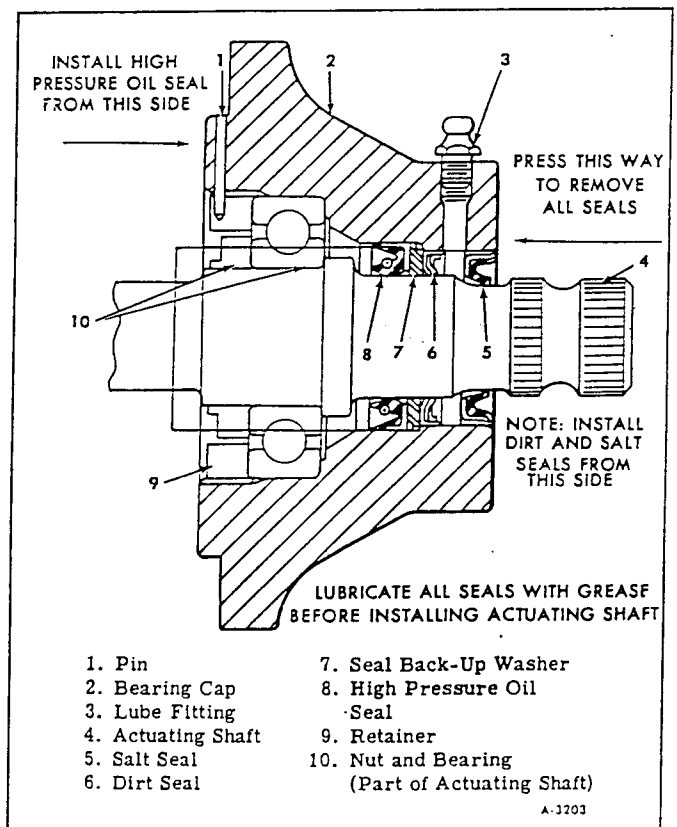


Figure 19 – Removing Seals from Bearing Cap

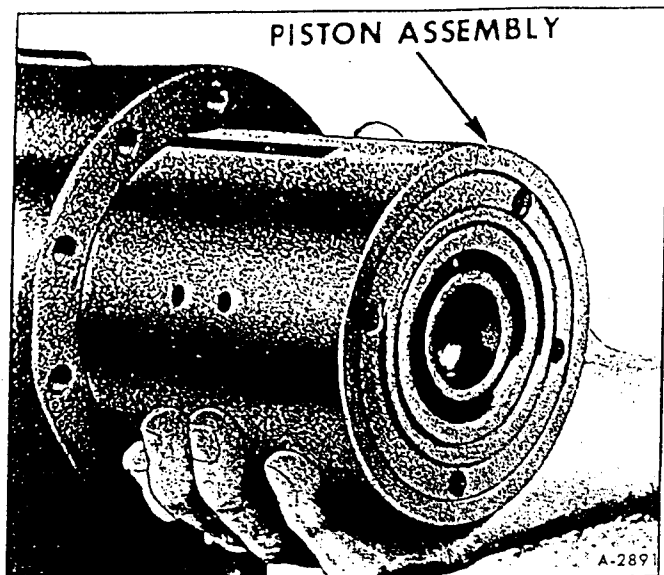


Figure 20 – Removing Piston from Gear Housing

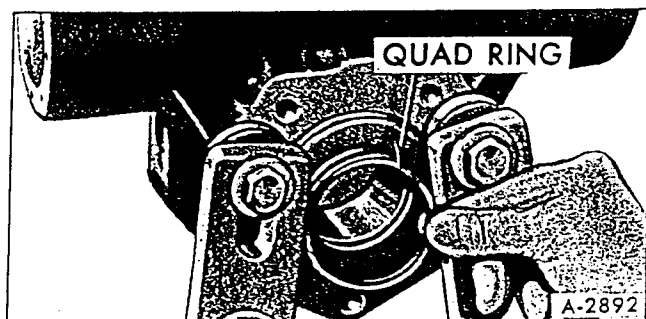


Figure 21 – Removing Quad Ring from Housing

10. Position one reversing spring in bottom of valve bore. Be sure spring is centered. End of the valve must enter inside diameter of the spring.

11. Install valve positioning pin in piston. Turn pin inward with a screwdriver until it is below outside surface of the piston. The flats must enter into the piston 1/4-inch to engage mating slot in the valve (fig. 26).

12. Carefully slide actuating valve into piston so that slot on end of valve is positioned over the pin.

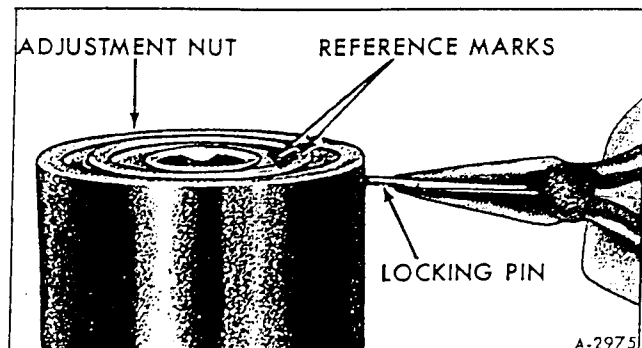


Figure 22 – Reference Marks on Piston and Nut

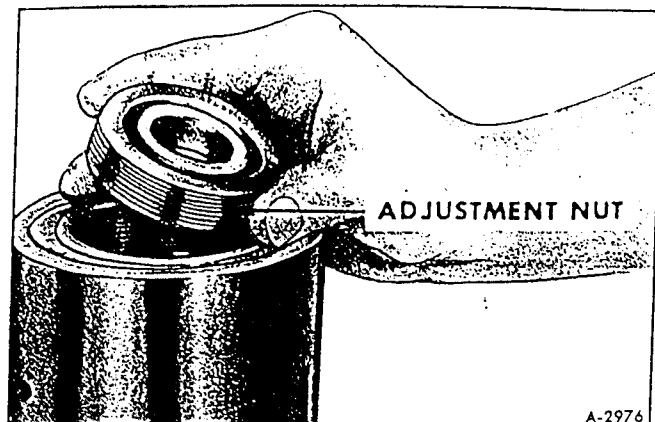


Figure 23 – Adjusting Nut Removal

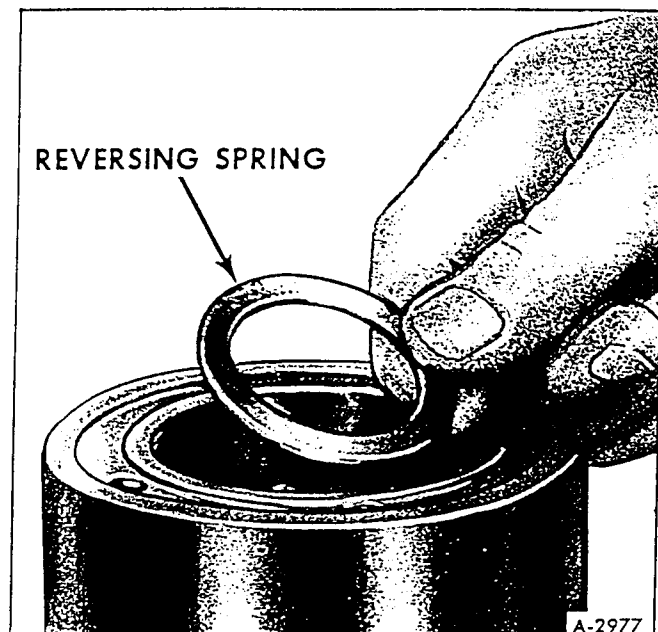


Figure 24 – Removing Reversing Spring

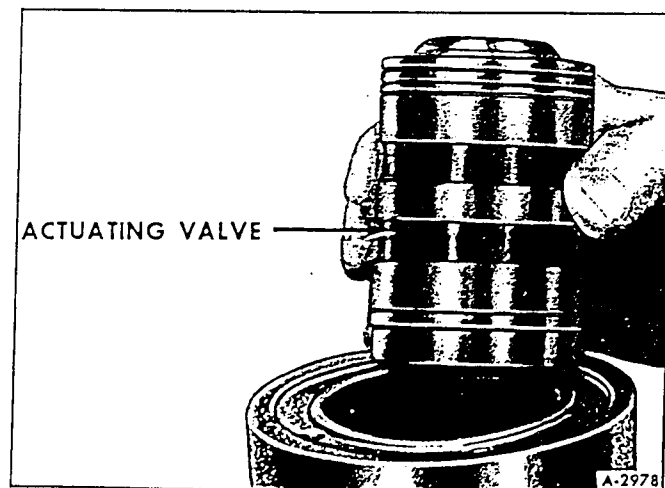


Figure 25 – Removing Actuating Valve

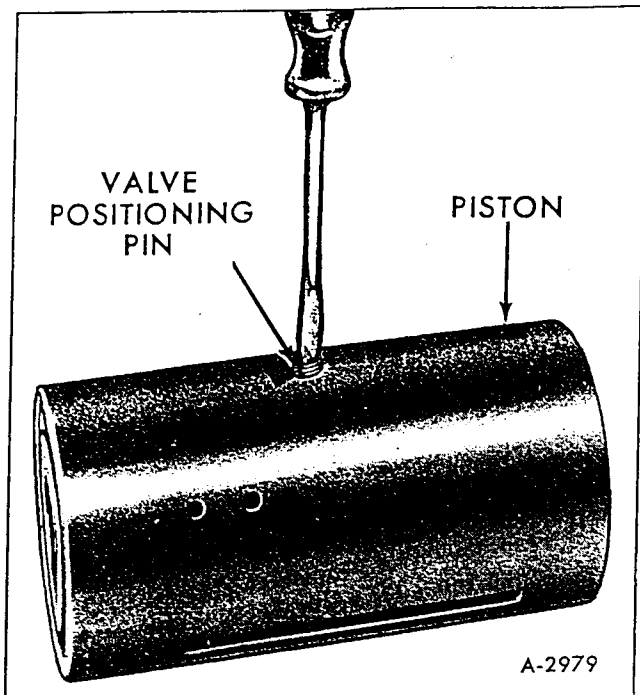


Figure 26 – Removing Valve Positioning Pin

13. Position remaining reversing spring on shoulder of valve end.

14. Install valve adjustment nut and turn it clockwise into the piston until it is against the spring. Align reference marks on nut and piston. Insert locking pin to lock nut in place. Be sure pin is below outside edge of piston.

STEERING GEAR ASSEMBLY

Cleanliness is of utmost importance. Use clean solvent to wash grease, oil, or dirt from all metal parts. Any bits of abrasive material which may get inside the housing during assembly procedures will quickly damage the gear mechanism. Clean machined parts individually to avoid damage due to "bumping" together of parts. Use clean lint free cloths, dipped in a clean solvent to clean all machined surfaces. After all parts are cleaned, dry with compressed air.

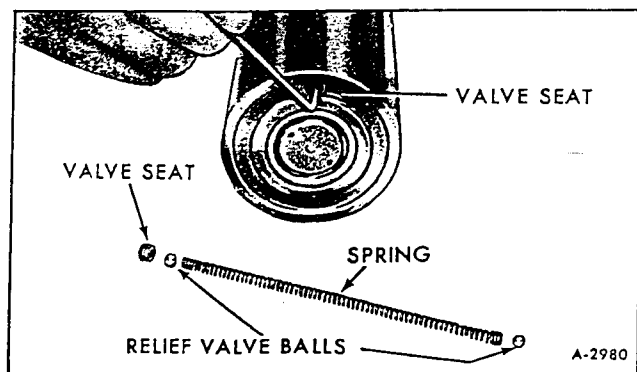


Figure 27 – Removing Valve Seat

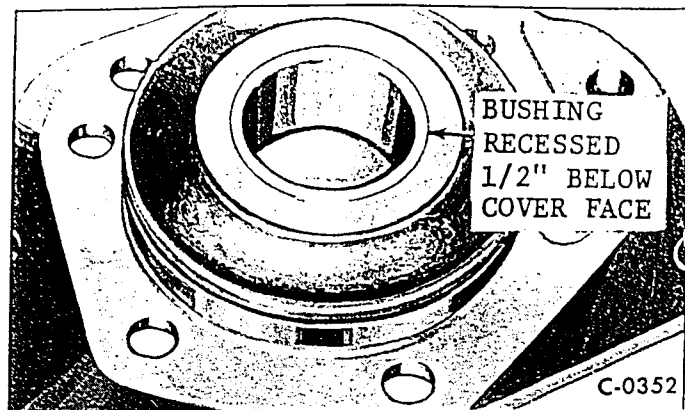


Figure 28 – Bushing Installed in Cover

1. If bushing was removed from cover, use a press and a straight line pushing action to press bushing into cover until face of bushing is recessed 1/2-inch below cover face (fig. 28).

2. If bushing was removed from gear housing, press bushing into gear housing until inside face of bushing is flush with inside face of gear housing (fig. 29).

If heavy press resistance was not encountered when bushing was pressed into output shaft bore of housing, carefully remove the bushing and proceed as follows:

a. Thoroughly clean bushing of oil and grease and clean housing bore by scraping with a piece of brass sheet.

b. Wash bushing and housing bore and dry thoroughly.

c. Coat exterior of bore and bushing with "Loctite" high strength retainer compound (or equivalent).

d. Press bushing into gear housing until inside face of bushing is flush with inside face of gear housing.

e. Allow a minimum of six hours curing time then remove excess compound from quad ring groove and housing by washing with naptha.

3. Install new quad ring in groove in gear housing.

4. Coat the piston and cylinder walls with 10 W 30 or 10W 40 multi-viscosity oil then install piston assembly in housing with actuating shaft opening facing the bearing cap end.

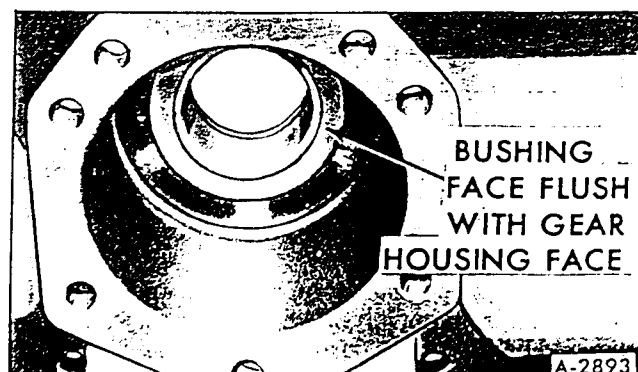


Figure 29 – Bushing Installed in Gear Housing

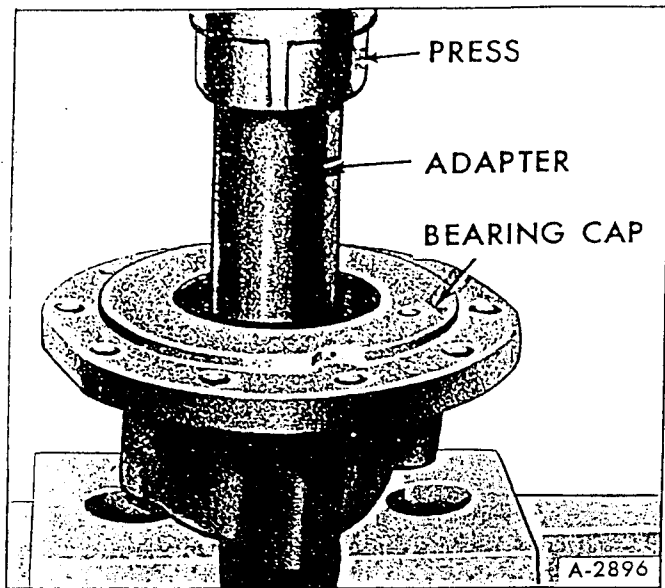


Figure 30 – Installing Oil Seal in Bearing Cap

5. Using a new gasket, install cylinder head on housing with alignment marks made at time of disassembly aligned. Be sure relief valve plunger opening is aligned with relief valve in piston. Install mounting bolts and tighten alternately and evenly to torque specified in "Specifications" at end of this section.

6. Install back-up washer in bearing cap with undercut positioned as shown in figure 19.

7. Fabricate a piece of 1 5/8-inch round stock approximately 2-inches long and turned to a diameter of 1.615". Be sure stock is smooth on one end.

a. Place round stock in bearing end of housing against back-up washer.

NOTE: Lubricate all seals with grease prior to installing bearing cap.

b. Position bearing cap on a press and evenly install dirt seal (fig. 31) (with lip out) from direction shown in figure 19 until it rests against the back-up washer.

c. Evenly install salt seal with lip out into bearing cap until it is flush with end of cap.

d. Turn bearing cap over and evenly install high pressure oil seal (figs. 19 and 30) until it rests against back-up washer.

8. Lubricate surface between seals with a suitable ball bearing lubricant then press actuating shaft assembly into the bearing cap (fig. 32).

9. Install bearing retaining nut. Insert locking pin through hole in bearing cap and into hole in nut.

NOTE: If a new nut is being used, drill a 3/32-inch hole in nut after it is in place. Drill through locking pin hole in bearing cap and 3/16-inch into the nut.

10. Position a new gasket on bearing cap then thread actuating shaft into the valve. Align punch marks on gear housing and bearing cap. Turn shaft until cap is properly aligned on end of cylinder. Check plunger hole alignment with valve seat in piston then install mounting bolts and

tighten alternately and evenly to torque specified in "Specifications" at end of this section.

11. If pinion gear was removed from output shaft, align timing mark on gear with marked spline on output shaft then press output shaft into the gear (fig. 33). Install a new retaining pin and secure with roll pin.

12. Insert output shaft into gear housing with aligning mark on center tooth of pinion gear aligned with mark on output shaft.

NOTE: Be careful that gear tooth and rack tooth are properly aligned. If tooth on pinion strikes the ground outside surface of the piston, a burr will be raised which will score that cylinder wall. Should this occur, use a fine hand stone to remove the burn before proceeding with assembly.

13. Position a new O-ring seal on housing cover. Position cover on housing and tap into place with a soft hammer. Install mounting bolts and tighten to torque specified in "Specifications" at end of this section.

14. Install relief valve plungers with jam nuts using new O-rings. Turn valve plungers approximately six turns. Final adjustment of plungers are made when steering gear is installed on the vehicle. Tighten jam nuts to secure plungers.

LUBRICATION

Keep power steering reservoir filled to the "FULL" mark with SAE 10W 30 or 10W 40 oil recommended in LUBRICATION (SEC. 13) of this manual.

NOTICE

DEXRON ® OILS ARE NOT COMPATIBLE WITH THIS SYSTEM AND MUST NOT BE USED.

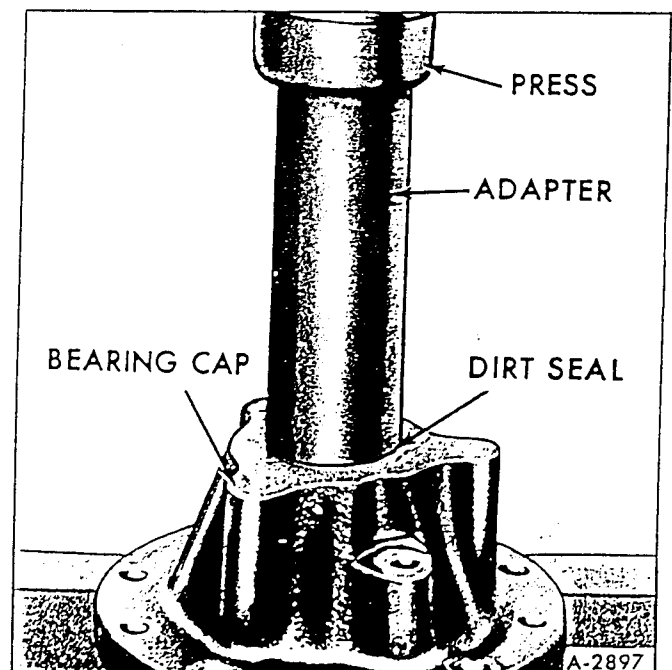


Figure 31 – Installing Dirt Seal in Bearing Cap

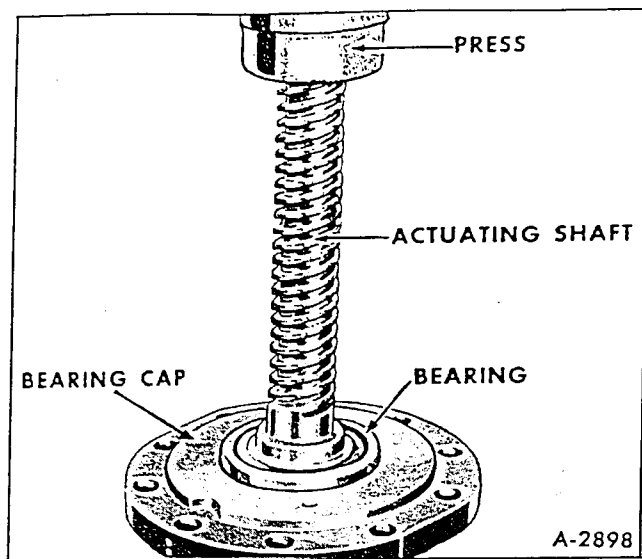


Figure 32 – Installing Actuating Shaft in Bearing Cap

When filling reservoir, start engine and turn steering wheel from left to right and continue filling until proper level is obtained.

A replaceable type filter element is located in pump reservoir. Every 20,000 miles or 600 hours remove reservoir cover and filter element. Clean inside of reservoir with a lint free cloth. Install a new filter element and replace cover.

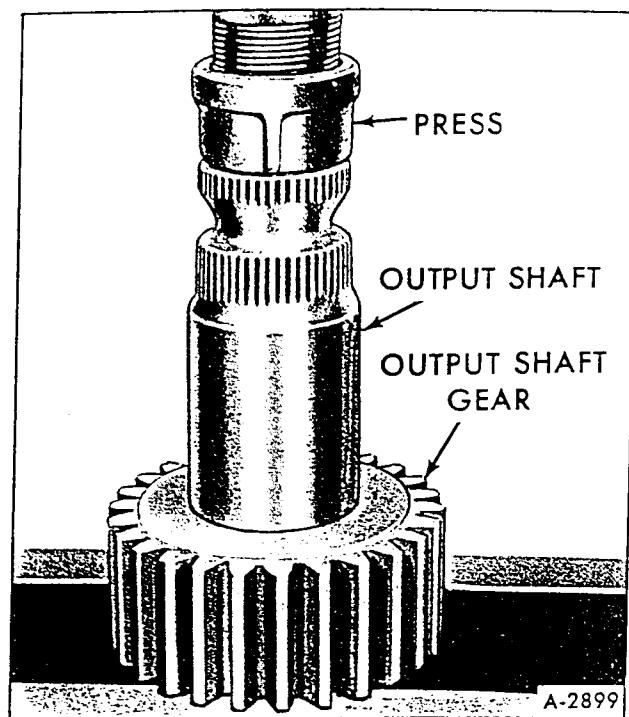


Figure 33 – Installing Output Shaft in Gear

STEERING DRAG LINK

DESCRIPTION AND MAINTENANCE

Drag link (fig. 20) is a three-piece type comprised of a tube and two socket end assemblies. Each drag link end is threaded into the tube and locked with a clamp bolt and nut. Right and left threads are provided to facilitate adjustments.

Linkage between steering gear and front axle affects steering action if parts are out of adjustment, bent, or twisted. Check steering geometry and front wheel alignment as directed in FRONT END ALIGNMENT (SEC. 1A) when steering linkage is repaired or replaced.

Drag link end sockets are self-adjusting and require no attention in service other than periodic lubrication and inspection to see that ball studs are in good condition.

Drag link end stud nuts must be kept tight or stud holes in steering arm and Pitman arm may become enlarged as a result of excessive looseness. Subsequent tightening of stud nuts may draw studs into arms so far that dust cover parts may be damaged. Replace socket ends when there is excessive up or down motion, lost motion, or end play at ball end of stud.

1. Periodically check clamp bolts for tightness. Tighten clamp bolt nuts to 45-55 foot-pounds torque.

2. Inspect drag link tube for bent or distorted condition. Inspect tube and socket ends for damaged threads and replace if there is evidence of damage.

3. Lubricate end sockets as directed in LUBRICATION (SEC. 13) in this manual.

DRAG LINK REPLACEMENT

REMOVAL

NOTE: Normal wear on bearing surfaces in drag link end sockets will result in increased overall height of the assembly. If excessive play is noted, drag link ends must be replaced.

1. Disconnect drag link ends from steering arm and Pitman arm by removing cotter pins and nuts from end studs and driving studs out of arms.

2. Loosen end socket clamp bolt nuts and thread end sockets out of drag link tube.

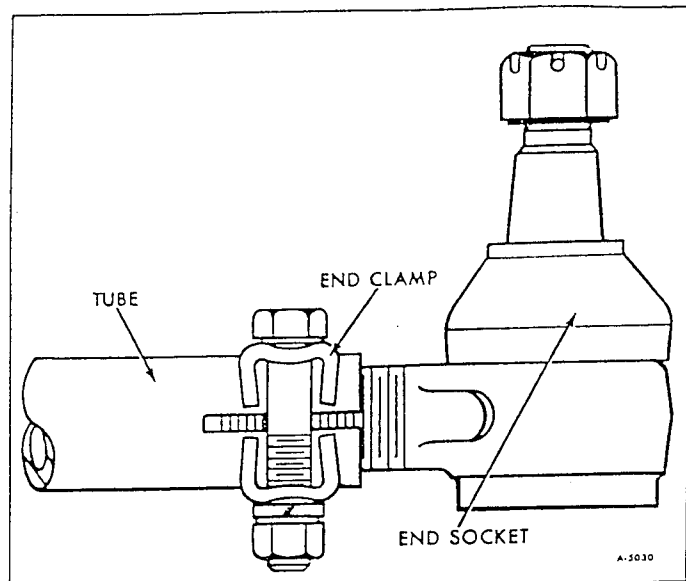


Figure 34 - Power Steering Drag Link

INSTALLATION AND ADJUSTMENT

1. Position front wheels in straight-ahead position.
2. Make certain that timing marks on steering gear output are aligned with timing mark on Pitman arm.
3. Thread drag link end assemblies into drag link tube but do not tighten clamp bolt nuts.
4. Place drag link in position on coach and attach to steering arm and Pitman arm with lock nuts.
5. Adjust drag link to 32.20-inches from centerline of stud at steering arm to centerline of stud at Pitman arm. Tighten clamp bolt nuts to 45-55 foot pounds torque. Tighten end socket stud nuts to 125-150 foot-pounds torque, then advance to next aligning cotter pin slot and install new cotter pins.
6. Test the adjustment. Front wheels should turn from right to left extremes without noticeable binding at drag link ends.

NOTE: Information on steering tie rod assembly is contained in FRONT AXLE REPAIR (SEC. 1B) in this manual.

POWER STEERING HYDRAULIC PUMP

OPERATION

The power steering pump (fig. 35), is a vane-type, hydraulic unit which supplies hydraulic power for operation of the steering gear at front axle. Pump is mounted at rear of engine, and is driven by the blower drive shaft through a coupling (fig. 36). The fluid reservoir and filter is remotely mounted and is connected to the hydraulic system by hoses.

PUMP OPERATION

Pump is composed principally of a pressure plate, ring, rotor, vanes, and wear plate (refer to fig. 35). The rotor is driven within the pump ring by a drive shaft, coupled to a power source. As the rotor speed increases,

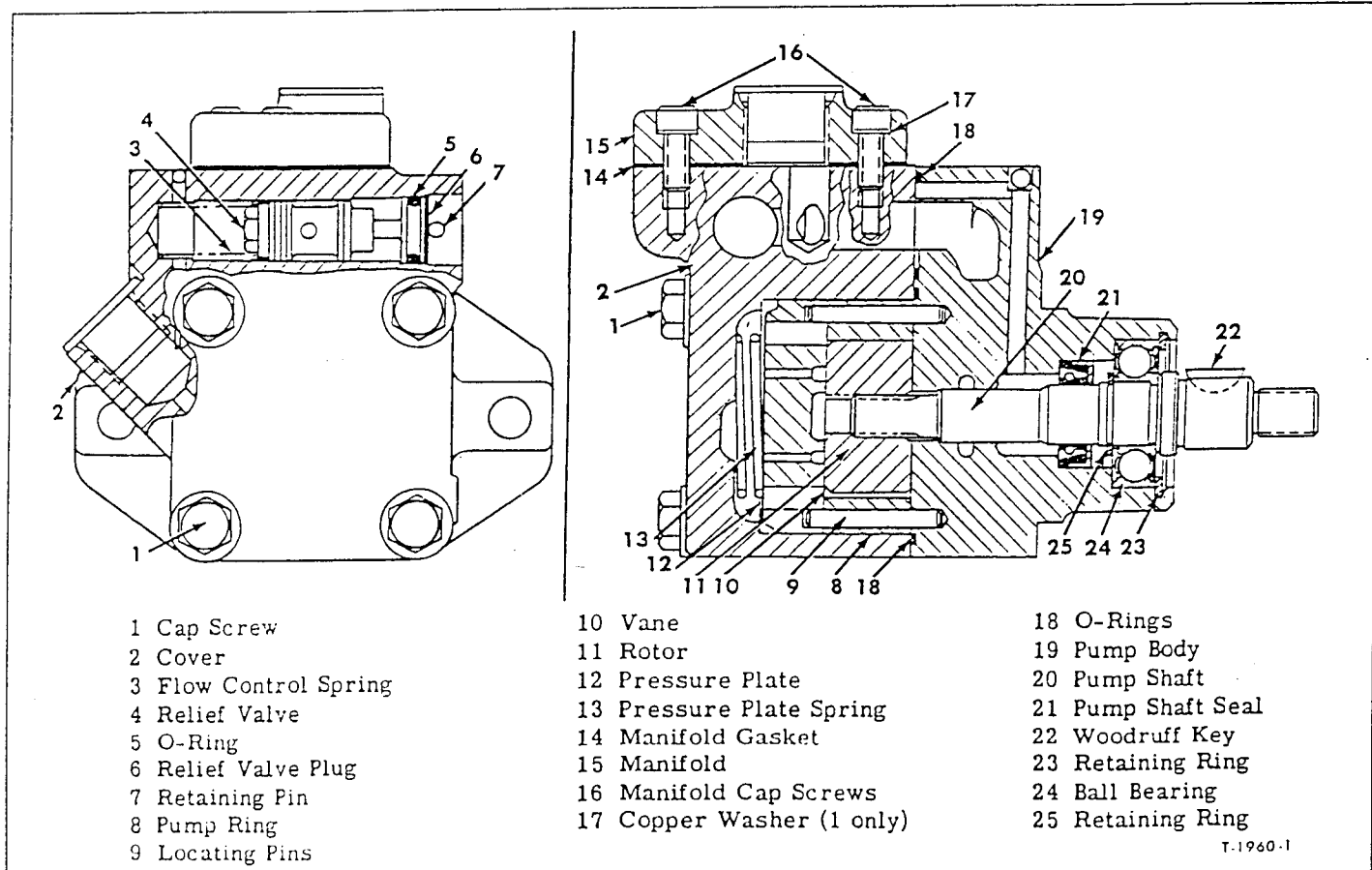


Figure 35 - Sectional View of Power Steering Hydraulic Pump

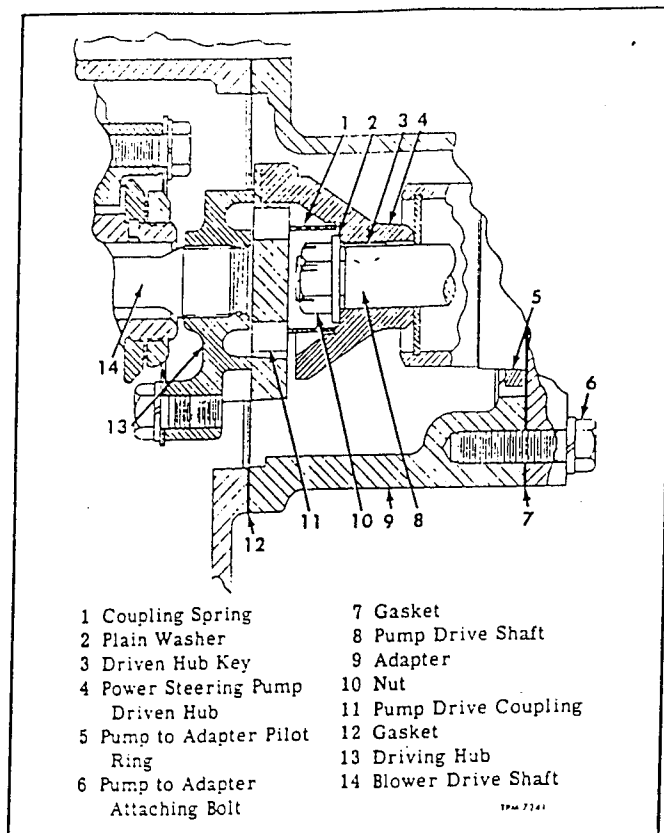


Figure 36 – Power Steering Pump Drive

centrifugal action causes the vanes to follow the cam-shaped contour of the pump ring (fig. 37). System pressure, fed behind the vanes, assures sealing contact of vanes on ring contour during normal operation.

The ring is shaped so that two opposing pumping chambers are formed. Radial movement of these vanes, and rotation of the rotor, causes the chamber area between vanes to increase in size at the inlet (large diameter) section of the ring. This results in a low pressure, or vacuum in the chamber. This pressure differential causes oil to flow into the inlet, where it is trapped between the rotating vanes and is forced, through porting in the pressure plate, to discharge into the system as the chamber size decreases at the pressure quadrant (small diameter) of the ring.

FLOW CONTROL AND RELIEF VALVE

Maximum pump delivery and maximum system pressure are determined by the integral flow control and relief valve in a special outlet cover used on pumps. This feature is illustrated schematically in figure 38. An orifice in cover limits maximum flow. A pilot-operated type relief valve shifts to divert excess fluid delivery to reservoir, thus limiting system pressure to a prescribed maximum.

View "A" shows the condition when the total pump delivery can be passed through the orifice. This condition usually occurs only at low drive speeds. The large spring chamber is connected to the pressure port through an orifice. Pressure in this chamber equalizes pressure at the other end of the relief valve spool and the light spring holds the spool closed. Pump delivery is blocked from the reservoir port by the spool land.

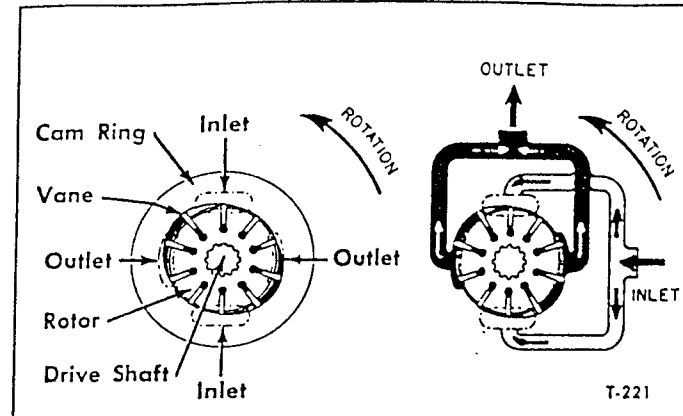


Figure 37 – Operation and Fluid Flow

When pump delivery is more than the flow rate determined by the orifice plug, a pressure build-up forces the spool open against the light spring. Excess fluid is throttled past the spool to the reservoir port as shown in View "B."

If pressure in the system builds up to 1500 psi \pm 50 psi (View "C"), the pilot poppet is forced off its seat. Fluid in the large spring chamber flows through the spool and out to reservoir. This flow causes a pressure differential on the spool, shifting it against the light spring. All pump delivery is thus permitted to flow to reservoir.

OPERATING INSTRUCTIONS

Normally, these pumps require no manual priming. However, it is essential that, after starting, a minimum drive speed of 600 rpm be held until the pump picks up its prime and pressure is built up in the system. Failure to observe the above precaution can result in scoring and possible seizure of the pump due to a lack of oil for lubrication.

MALFUNCTION

For diagnosing and remedy of trouble relative to power steering hydraulic pump see "Power Steering Troubleshooting Guide" at end of this section.

HYDRAULIC FLUID RECOMMENDATIONS

Refer to LUBRICATION (SEC. 13) for type of fluid and intervals of service required for the power steering system.

HYDRAULIC PUMP REPLACEMENT

REMOVAL

NOTE: Key numbers numbers in text refer to figure 36.

1. Place a clean pan under power steering pump pressure and return flexible lines and pump ports to catch hydraulic fluid; then remove lines from pump by unscrewing fittings.

2. Remove bolts, nuts, and lock washers attaching power steering pump and adapter assembly to engine flywheel housing.

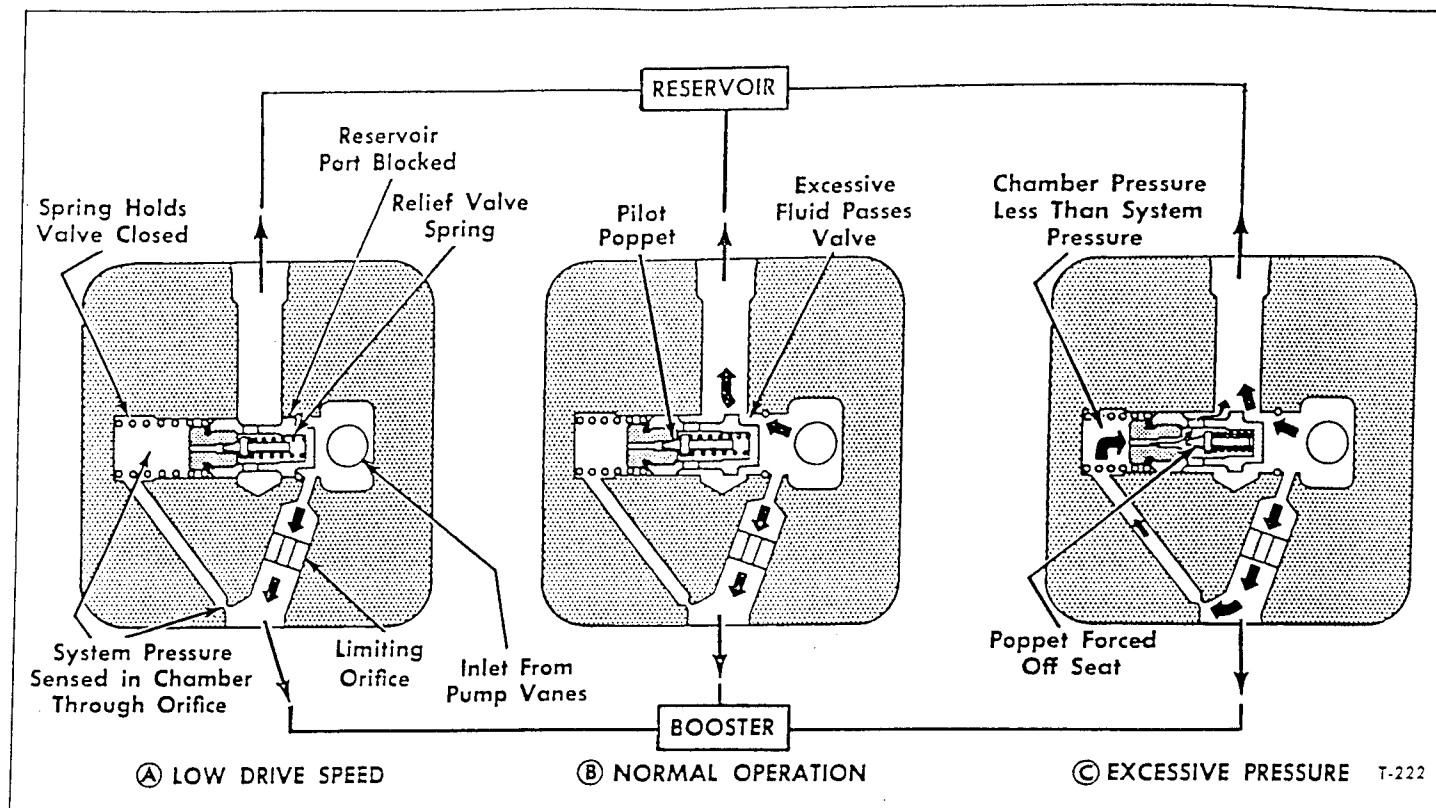


Figure 38 - Hydraulic Pump Flow Control and Relief Valve Operation

3. Using care to avoid dropping coupling ring (11) and coupling spring (1), remove pump and adapter assembly from engine.

4. Remove coupling ring (11) and coupling spring (1); then remove adapter to housing gasket (12). Discard gasket.

5. Remove locknut (10) and plain washer (2) attaching driven hub (4) to pump drive shaft (8).

6. Remove two bolts (6) and lock washers attaching pump to adapter.

7. Remove gasket (7) from pump and discard.

INSTALLATION

NOTE: Key numbers in text refer to figure 36.

1. If previously removed, install Woodruff key (3) in slot of pump drive shaft (8).

2. Position pump driven hub (4) on pump drive shaft (8), aligning Woodruff key in drive shaft with slot in hub (4).

3. Install plain washer (2) and lock nut (10) attaching pump driven hub (4) to pump drive shaft (8).

4. Install coupling spring (1) and coupling ring (11) in pump adapter, engaging prongs of driven hub (4) with slots in coupling ring (11).

5. Install adapter to flywheel housing, attaching with bolts, nuts, and lock washers. Tighten securely.

6. Connect power steering pump pressure and return flexible lines to pump. Tighten fittings.

7. Refill power steering hydraulic system and bleed system as described previously under "Bleeding Power Steering System."

HYDRAULIC PUMP OVERHAUL

Overhaul of power steering hydraulic pump must be undertaken in clean working area with pump removed from coach engine. It is important that overhaul procedures described in the following text be carefully followed:

DISASSEMBLY

NOTE: Key numbers in text refer to figure 39.

1. Using a suitable cleaning solvent, thoroughly clean the exterior of the hydraulic pump to prevent entry of dirt or other foreign matter into the pump during overhaul procedures.

2. Remove three manifold cap screws (6) and copper washer (7). Remove manifold (5). Remove and discard manifold gasket (4).

3. Remove cover mounting cap screws (1) and separate the cover (3) from the pump body (19).

4. Remove pressure plate spring (8) and pressure plate (13).

5. Remove pump ring (15), locating pins (14), rotor (16) and vanes (17) and the two O-rings (18).

6. Mount the cover (3) in a vise. Drive out retaining pin (2) with a suitable punch. Protect the relief valve plug and subassembly against falling from bore. Work the plug (12), relief valve (10) and spring (9) from the bore.

NOTE: Access to the relief valve plug and subassembly may be gained through the large chamfered hole which leads to relief valve bore from inside the cover.

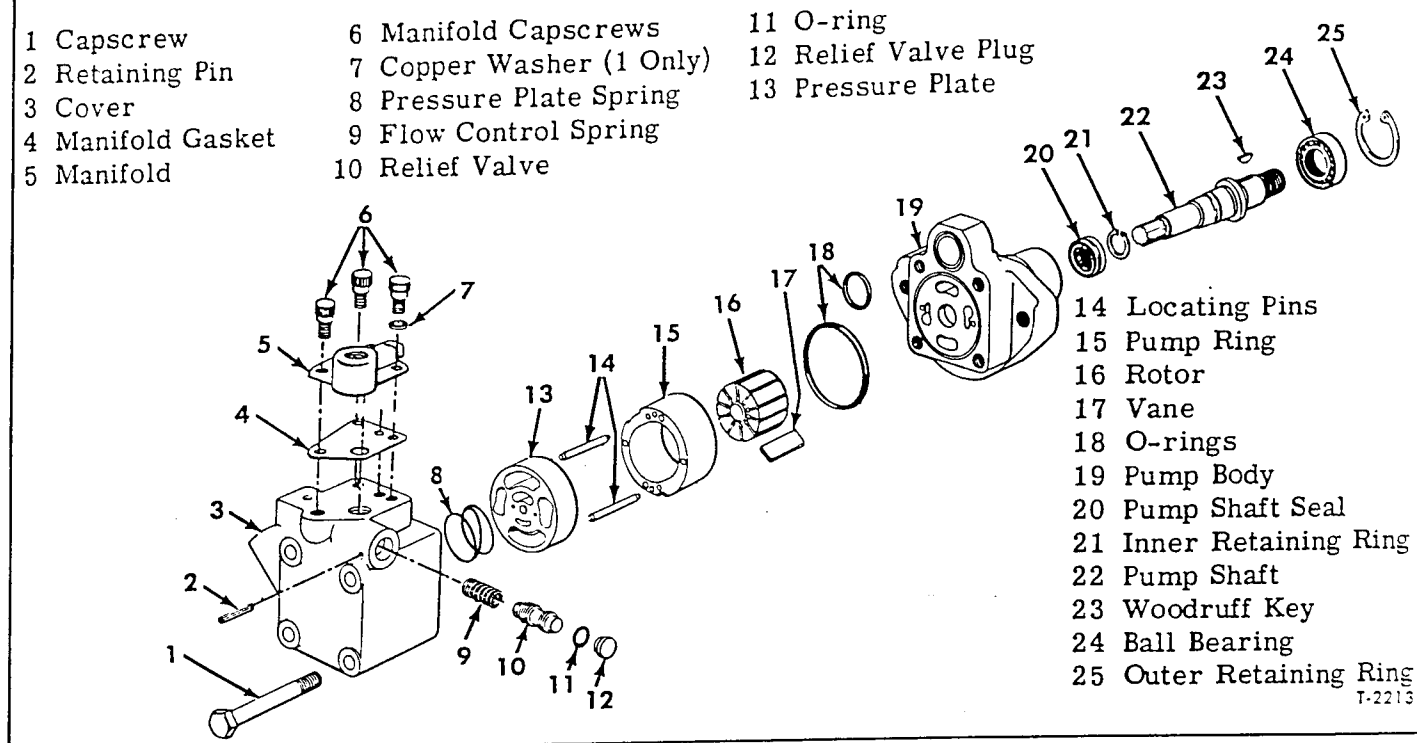


Figure 39 – Power Steering Hydraulic Pump Components

7. Remove outer retaining ring (25) from pump body (19).

8. Support the shaft end of the pump body (19) in a two-inch straight pipe coupling and, using an arbor press, remove the shaft (22). The shaft assembly should drop through a slot in the press table so the shaft will not be damaged.

9. Remove inner retaining ring (21) and ball bearing (24) from shaft (22).

10. Press shaft seal (20) from pump body (19).

INSPECTION

NOTE: Wash all parts, except seals, in clear mineral solvent and lay them aside for inspection. Replace all old seals and O-rings at reassembly.

1. Ring, Rotor, Vanes, Pressure Plate, Body Inspect the surfaces of all parts which are subject to wear. Light scoring may be removed from the faces of the body or wear plate with crocus cloth (by placing the cloth on a flat surface), medium stone or by lapping. Check the edges of vanes for wear. Vanes must not have excessive play in slots or burrs on edges. Replace if necessary. Check each rotor slot for sticky vanes or wear. Vanes should drop in rotor slots by their own weight when both slot and vane are dry.

2. Relief Valve — Insert valve in its bore in pump cover. There should be no binding. Check valve and bore for excessive wear and scoring. Replace if necessary.

3. Bearing — Wash bearing thoroughly. Inspect and replace bearing if worn or damaged.

4. Shaft and seal — Replace the shaft seal at each overhaul to prevent oil leakage. Check the drive shaft oil seal diameter for wear and scoring. Do not install a new seal on a shaft which is worn or damaged at the oil seal diameter. Replace the shaft if worn. Stone and polish the sharp edges on the shaft to prevent damage to the seal.

5. Body and Cover — Stone all mating surfaces with a medium stone to remove all burrs and sharp edges. Rewash all parts after stoning.

ASSEMBLY

NOTE: Immerse all parts in clean hydraulic oil to facilitate reassembly. Refer to figure 39.

1. Press shaft seal (20) in pump body (19).

2. Press ball bearing (24) onto shaft, and position inner retaining ring (21) on shaft against bearing.

3. Insert shaft (22) in pump body (19), and insert outer retaining ring in body at shaft end.

4. Install locating pins (14) in pump body (19). Install pump ring (15) over pins in counterclockwise rotation as viewed from shaft end.

5. Position rotor (16) in pump ring (15) with chamfered edge of splined hole “in” or toward pump body (19). The chamfer facilitates assembly.

6. Install vanes (17) with their radius edge toward the inner ring contour.

7. Oil the pump ring (15) and rotor (16) with clean hydraulic oil and install pressure plate (13).

8. Install O-rings (18). Install pressure plate spring (8) and cover (3). Tighten cover screws (1) to torque listed in “Specifications.”

9. Install pressure compensating spring (9) in relief valve bore. Insert valve assembly (10) with the hex toward the spring. Install plug (12) with O-ring (11) in bore and hold it in position while driving a new retaining pin (2).

10. Position new manifold gasket (4) and manifold (5) on pump cover and secure manifold to pump body with screws (6). Copper washer (7) is used on screw where tapped hole enters oil passage. Tighten screws to torque listed in “Specifications.”

POWER STEERING FLUID RESERVOIR AND FILTERS

FLUID RESERVOIR

The power steering reservoir and filter assembly (fig. 40) is bracket mounted in upper right-hand corner of engine compartment.

It is recommended that the fluid reservoir cover be removed and element replaced every 100,000 miles or 6-months, whichever occurs first dependent upon operating conditions. Any time power steering reservoir has been serviced, power steering hydraulic system must be bled to remove air from the system.

SERVICING RESERVOIR FILTER (Refer to fig. 40)

1. Disconnect hose from reservoir outlet (12) and drain fluid.
2. Remove filler cap (2) and dipstick (1) assembly.
3. Remove cover bolt (3) and gasket (4).

CAUTION: Hold cover (5) so compression of spring (7) will not cause it to fly off.

4. Remove cover (5) and hold-down spring (7).
5. Remove basket-type filter screen and washer assembly (8).
6. Remove filter element cartridge (9).
7. Rinse filler cap (2) in suitable solvent to remove accumulated dirt. If unable to clean satisfactorily, disassemble filler cap (2) and replace polyethylene filter.
8. Wipe out reservoir shell (10) with dry, clean, lint-free cloth.

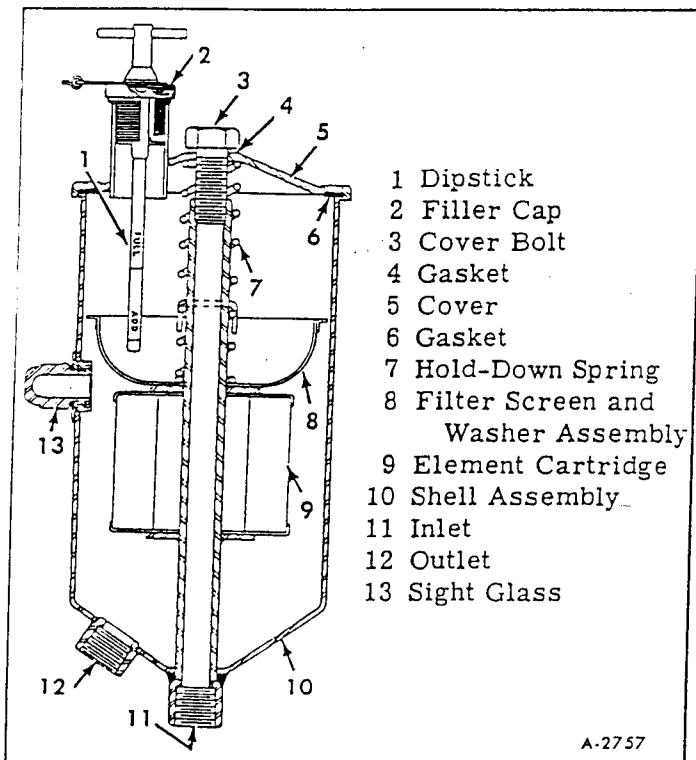


Figure 40 - Power Steering Reservoir and Filter

9. Install new element cartridge (9).
10. Wash filter screen and washer assembly (8) in suitable solvent, dry thoroughly and install in shell (10).
11. Install hold-down spring (7).
12. Install new gasket (6) in cover (5) and place cover on shell.
13. Install new gasket (4) on cover bolt (3) and install bolt to secure cover.
14. Fill reservoir with fluid and bleed system as previously described.
15. Install filler cap (2) and dipstick (1) assembly.

FLUID LINE FILTER

Power steering fluid filter assembly is bracket mounted to engine bulkhead.

At regular lubrication intervals, fluid filter bowl should be removed and element and magnetic plug cleaned. Any time power steering fluid filter had been serviced, power steering hydraulic system should be bled. Refer to "Bleeding Power Steering Hydraulic System" explained earlier in this section.

SERVICING FLUID LINE FILTER (Refer to Fig. 41).

NOTE: The fluid line filter assembly can be serviced without removing complete assembly from coach.

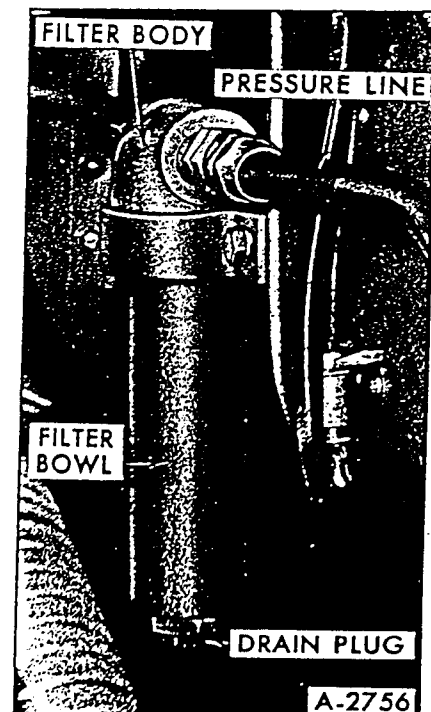


Figure 41 - Fluid Filter Installed

1. Using a wrench on wrench flats, turn filter bowl out of threads of filter head.
2. Remove and discard filter bowl gasket.
3. With a small wrench, unscrew filter element assembly from filter head. Use care to avoid damage to element. Clean parts, using cleaning solvent and compressed air.

4. Remove fluid line filter magnetic drain plug from bottom of filter bowl. Clean all metallic material from plug magnets.

5. Re-assemble filter, then bleed hydraulic system as directed earlier under "Bleeding Power Steering Hydraulic System."

POWER STEERING DIAGNOSIS

STEERING GEAR DIAGNOSIS

SYMPTOM	PROBABLE CAUSE	REMEDY
Excessive pump pressure with steering gear in neutral position.	Kink in oil return line.	Relocate line to remove kink.
Erratic steering or no steering at all.	Insufficient volume of oil being metered by flow control to steering gear induced by foreign particles on flow control valve, causing valve to hang up in the bore.	Polish flow control valve to remove foreign particles and burrs. Refer to Hydraulic pump overhaul later.
Erratic steering or no steering at all.	Flow control spring takes permanent set because of fatigue, thereby, allowing flow control valve to move easily and reduce oil volume.	Replace flow control valve spring. Refer to pump service instructions.
Erratic steering or no steering at all.	Broken by-pass spring in flow control valve.	Replace with flow control valve assembly, which includes by-pass spring. Refer to pump servicing instructions.
Side motion in steering wheel.	Worn bearing in steering column.	Replace bearing.
Excessive backlash.	Worn universal joint.	Replace universal joint.
Excessive backlash.	Worn linkage between actuating shaft and universal joint to steering shaft.	Replace pins and keys.
Excessive backlash.	Low oil volume.	Check flow divider and pump pressure.
Excessive backlash.	Pitman arm ball worn "Egg/Shaped."	Replace Pitman arm assembly.
Excessive backlash.	Improperly adjusted drag link, Pitman arm to drag link and steering arm to drag link.	Adjust drag link, drag link to Pitman arm and drag link to steering arm.
Wheel steering hard in one or both directions.	Bent or damaged king pins and tie rods.	Repair or replace king pins and tie rods. Refer to servicing instructions.
Wheel steering hard in both directions.	Low oil level in steering system.	Fill oil reservoir as required. See LUBRICATION, (SEC. 13).
Wheel steering hard in both directions.	Air in system.	Bleed system and check for cause of air.
Wheel steering hard in both directions.	Caster and camber degree incorrect.	Correct to "Specifications." See FRONT END ALIGNMENT (SEC. 1).
Oil leaking at actuating shaft of steering gear.	Worn or damaged oil seal.	Replace oil seal.
Oil leaking at output shaft of steering gear.	Restricted oil return line.	Check for obstructions and sharp bends in line.
Oil leaking at output shaft of steering gear.	Worn or damaged quad ring.	Replace quad ring.
Oil leaking at output shaft of steering gear.	Worn cover bushing and/or output shaft bushing.	Replace bushings.

POWER STEERING DIAGNOSIS (Cont'd)

STEERING GEAR DIAGNOSIS

SYMPTOM	PROBABLE CAUSE	REMEDY
Wheel steering hard in one or both directions.	Metal or foreign material caught in actuating valve. Actuating valve worn or chipped by dirt.	Remove actuating valve, clean and check parts for damage. If damage is excessive, replace with actuating piston and valve assembly.
Oil leaking at output shaft of steering gear.	Worn or damaged output shaft.	Replace output shaft.
Oil leaking at actuating shaft of steering gear.	Worn or damaged actuating shaft.	Replace with actuating shaft assembly.
Wheel steering hard in one direction.	Broken reversing springs in steering gear.	Replaces reversing springs.
Excessive backlash.	Worn or damaged actuating valve.	Replace with actuating piston and valve assembly.
Excessive backlash.	Rack or piston worn or damaged.	Replace with actuating piston and valve assembly.
Excessive backlash.	Worn or damaged pinion gear on output shaft.	Replace pinion gear.

HYDRAULIC PUMP DIAGNOSIS

SYMPTOM	PROBABLE CAUSE	REMEDY
PUMP NOT DELIVERING OIL	DRIVEN IN WRONG DIRECTION OF ROTATION.	Check direction of pump shaft rotation. (L.H. rotation when viewed from shaft end).
	PUMP DRIVE SHAFT DISENGAGED OR SHEARED.	Remove pump; determine damage to cartridge parts (see disassembly instructions) replace sheared shaft and needed parts.
	FLOW CONTROL VALVE STUCK OPEN.	Disassemble pump and wash control valve in a clean solvent. Return valve to its bore and slide it back and forth. No stickiness in movement should occur. If a gritty feeling is noted on the valve O.D. it may be polished with crocus cloth. Avoid removal of excess material or rounding of valve edges during this operation. Do not attempt to polish the valve bore. Wash all parts before reassembly of pump. Flush entire system thoroughly and fill with clean oil.
	VANE OF VANES STUCK IN ROTOR SLOTS.	Disassemble pump, examine rotor slots for dirt, grime or small metal chips. Clean rotor and vanes, in a good grade solvent (mineral spirits or kerosene) reassemble parts and check for free vane movement.

HYDRAULIC PUMP DIAGNOSIS (Cont'd.)

SYMPTOM	PROBABLE CAUSE	REMEDY
PUMP NOT DELIVERING OIL (CONT.)	OIL VISCOSITY TOO HEAVY TO PICK UP PRIME	Use fluid of the proper viscosity as recommended 10W30 or equivalent.
	PUMP INTAKE PARTIALLY BLOCKED.	Drain system completely; flush to clear pump passages. Flush and refill system with clean oil as per recommendations.
	AIR VENT FOR RESERVOIR CLOGGED OR DIRTY STRAINER.	Remove filler cap and clean air vent clot. Check filter for strainer in tank for clogged condition. Drain, flush and add clean oil to system if strainer was clogged.
PUMP MAKING NOISE	RESTRICTED OR PARTIALLY CLOGGED INTAKE LINE OR CLOGGED FILTER.	Pump must receive intake oil freely or cavitation will result. Drain system, and clean intake line and strainers. Add new oil and strain by recommended procedures.
	AIR LEAK AT PUMP INTAKE PIPING JOINTS OR PUMP SHAFT SEAL	Testing by pouring oil on joints and around drive shaft. Listen for change in operation. Tighten joints affected and replace pump drive shaft seal according to service instructions as outlined.
	COUPLING MISALIGNMENT	Re-align and replace oil seal and bearings if damaged by shaft misalignment.
	RESERVOIR OR MANIFOLD SEAL LEAKAGE.	Leakage between manifold or reservoir at replenishing hole due to O-ring damage. Reservoir inlet tube to pump cover O-ring should be carefully examined for damage such as cuts, nicks, or dirt.

POWER STEERING SPECIFICATIONS

STEERING GEAR

Make	Sheppard
Type	Hydraulic
Gear Ratio	18.4 to 1
Model	492-AP-1
Oil Flow (GPM)	
Minimum	3.5 (GPM)
Maximum	4.5 (GPM)
Operating Pressure	1450-1550
Output Shaft Bearings	
Type	Bronze
Outside Diameter	2.6260"-2.6265"
Inside Diameter	2.2531"-2.2536"
Width	1.500"-1.510"

STEERING COLUMN AND BEVEL GEAR

Steering Wheel Diameter	22"
Steering Bevel Gear Ratio	1 to 1
Upper Bevel Pinion — Number of Teeth	18
Lower Bevel Pinion — Number of Teeth	18
Backlash Between Gears Theoretical	Min. .004
	Max. .006

BEARINGS

Steering Shaft Upper Type	Special Ball
Upper to Lower Steering Shaft Universal	
Type	Roller
Number of Rollers	20

POWER STEERING SPECIFICATIONS (Cont'd.)

STEERING COLUMN AND BEVEL GEAR (Cont'd.)

BEARINGS (Cont'd.)

Lower Steering Shaft Upper	
Type	Roller
Outside Diameter	1.6250"-1.6260"
Inside Diameter	1.1245"-1.1250"
Width	1.6250"-1.6260"
Number of Rollers	12
Lower Steering Shaft Lower	
Type	Roller
Inside Diameter	1.002"-1.007"
Outside Diameter	1.5420"-1.5520"
Width	0.0779"-0.0781"
Number of Rollers	30
Bearing Race	
Inside Diameter	1.002"-1.012"
Outside Diameter	1.532"-1.552"
Thickness	0.124"-0.126"
Bevel Gear Bearing	
Type	Roller
Inside Diameter	0.377"-0.382"
Outside Diameter	0.792"-0.802"
Width	0.779"-0.781"
Number of Rollers	12
Bearing Race	
Inside Diameter	0.377"-0.387"
Outside Diameter	0.782"-0.802"
Width	0.030"-0.032"
Bevel Gear Housing	
Type	Roller
Inside Diameter	0.9995"-1.0000"
Outside Diameter	1.2495"-1.2505"
Width	0.740"-0.750"
Housing Cap	
Type	Needle
Inside Diameter	1.4995"-1.5000"
Outside Diameter	1.8745"-1.8755"
Width	0.990"-1.000"
Pinion Gear	
Type	Needle
Inside Diameter	1.6245"-1.6250"
Outside Diameter	1.9995"-1.0005"
Width	0.615"-0.625"

ADJUSTMENTS

Upper Bevel Pinion	
Adjustment Type	Shims
Shim Thickness Available	0.003" & 0.010"
End Play	None
Lower Bevel Pinion	
Adjustment Type	Adjuster Screw
End Play	None

POWER STEERING HYDRAULIC PUMP

Pump Rotation	Counterclockwise
Make	Vickers
Model	VTM-27-50-40-15-MJ-L1-14-S4
Type	Hydraulic Vane
Capacity	5.0 GPM @ 1200 RPM
Pump Rotor	
Width	0.9210"-0.9212"
Outside Diameter	1.5930"-1.5980"
Number of Vane Slots	10
Vane Slot Width	0.0780"-0.0785"
Rotor Vanes	
Quantity	10
Thickness	0.0770"-0.0775"
Width	0.3430"
Length	0.9206"-0.9209"
Outer Bearing	
Type	Ball
Outside Diameter	1.5743"-1.5748"
Inside Diameter	0.6690"-0.6693"
Width	0.647"-0.472"
Diameter of Balls	5/16"
Number of Balls	7
FLOW CONTROL VALVE	
Opening Pressure	1500 PSI (± 50 PSI)
FLOW CONTROL VALVE SPRING	
Free Length	2.5470"
Compressed Length	
Under 6.25 Lbs.	1.2970"
Under 8.2 LBBS.	0.9060"
PUMP SHAFT	
Diameter at Ball Bearing	0.6693"-0.6697"
Diameter at Oil Seal	0.6250"
Length of Spline	0.6250"
Number of Splines	14

STEERING DRAG LINK

Type	Adjustable
Length — Centerline of Stud Centers	Approx. 32.20"
Springs	
Stud Seat Spring	
Free Length	0.750"
Compressed Length Under 350-400 Lbs.	0.500"
Free Length	1.250"
Compressed Length Under 30 Lbs.	0.875"

RESERVOIR AND FILTER

Element	Disposable Cartridge
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SPECIFICATIONS (CONT'D)

POWER STEERING TORQUE SPECIFICATIONS

ITEM	QUANTITY	TORQUE (FOOT-POUNDS)
Steering Wheel to Shaft Nut	1	45-55
Steering Gear to Axle Support Clip Nut	1	90-110
Steering Gear to Front Axle Beam Bolt	2	170-180
Cylinder Head and Bearing Cap Bolt	1	
Mounting Plate Bolts		115-125
Mounting Plate U-Bolt Nuts		218-225
Pitman Arm to Steering Shaft Nut	1	675
Pitman Arm to Shaft Nut Socket Head Cap Screw	1	15-20
Bevel Gear Mounting Bracket to Spare Tire Compartment Side Panel Bolt Nut	3	35-45
Steering Column to Housing Bracket Bolt Nut	3	50-60
Steering Propeller Shaft Bearing Support Bolt Nut	1	25-30
Front Propeller Shaft to Steering Gear Bolt Nut	1	15-20
Rear Prop Shaft to Steering Gear Bolt Nut	1	25-30
Steering Column Clamp Plate Support Floor Support Bolt Nut	1	15-20
Clamp Plate to Support Bolt	2	30-35
Steering Column to Clamp Plate U-Bolt Nut	2	5-7
Propeller Shaft to Yoke U-Bolt Nut	3	15-20
Propeller Shaft to Column Bolt	1	15-20
Power Steering Pump to Adapter Bolt	2	25-30
Power Steering Pump Driven Hub to Shaft Nut	1	60-70
Pump Reservoir Bracket to Engine Cradle Hanger Bolt-Nut	2	15-20
Filter to Bracket Bolt Nut	1	15-20
Hydraulic Pump Reservoir Cover Bolt	1	35
Bevel Gear Housing to Bracket Nut	1	50-60
Pinion Gear to Steering Shaft Nut	1	40-50
Upper Cover to Bevel Gear Housing Bolt	1	25-30
Cap to Bevel Gear Housing Bolt	1	20-25
Universal Upper Housing to Jacket Bolt Nut	1	15-20
Universal Lower Housing To Upper Housing Bolt	1	20-25
Steering Column Shaft to Universal Joint Nut	1	20-25
Tie Rod to Steering Arm Stud Nut	2	150*
Tie Rod End Clamp Bolt Nut	2	45-55
Drag Link to Steering Arm Stud Nut	1	150*
Drag Link to Pitman Arm Stud Nut	1	150*
Drag Link Socket End Clamp Nut	2	45-55

*Tighten Nut to torque specified, then advance to next Pin Slot and install Cotter Pin.